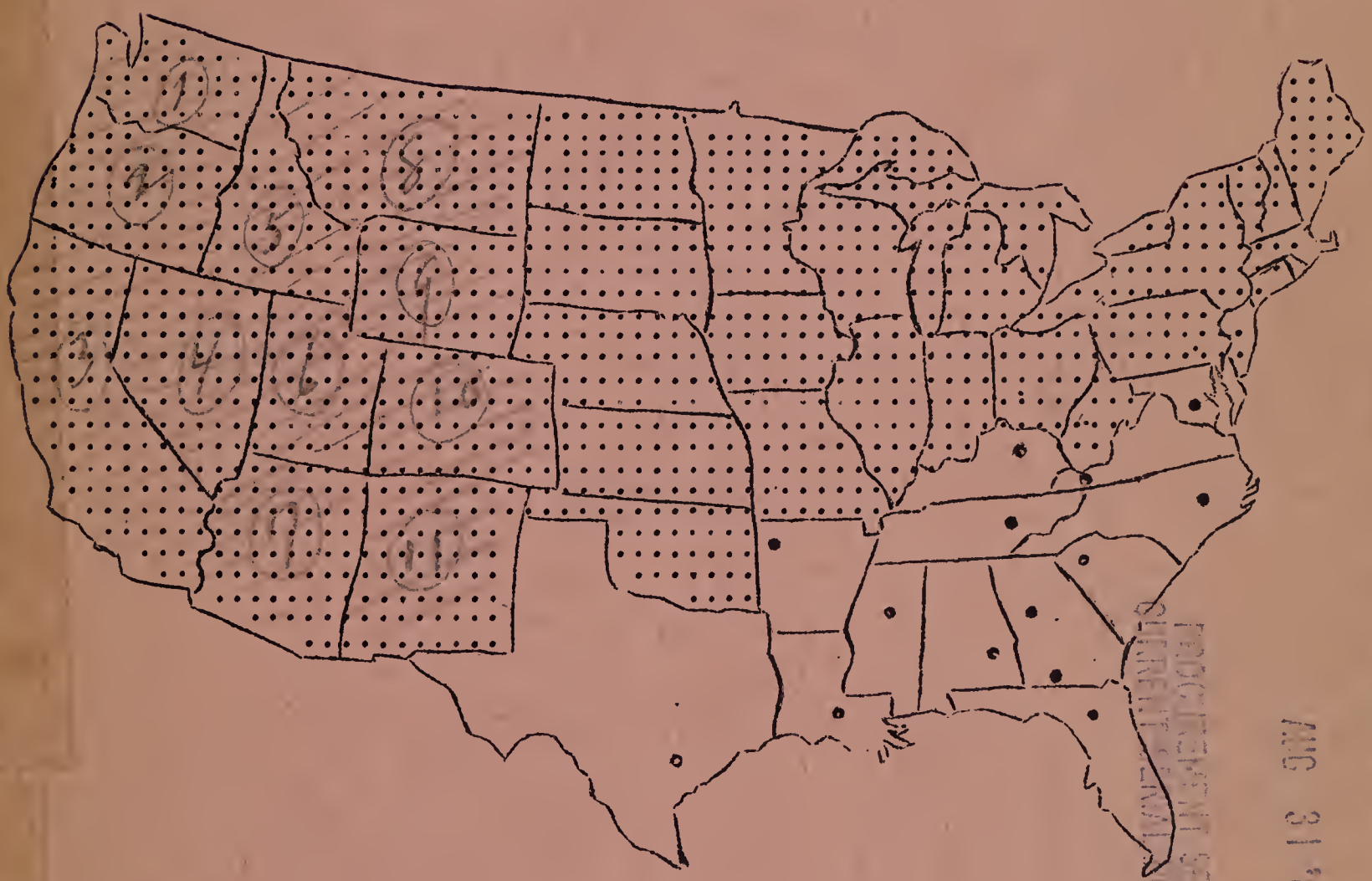
U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
ANIMAL AND POULTRY HUSBANDRY RESEARCH BRANCH
AND
COOPERATING SOUTHERN STATES

1953 Annual Report of S-10 IMPROVEMENT OF BEEF CATTLE FOR THE SOUTHERN REGION THROUGH BREEDING METHODS

January 1, 1954



This is a report submitted by project leaders of Project S-10 "Improvement of Beef Cattle for the Southern Region Through Breeding Methods", and compiled by the Regional Coordinator. It is intended for use of administrative leaders and workers in developing the project, and is not for general publication.

C O N T E N T S

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Ky

Maine

INTRODUCTION

Everett J. Warwick

The material in the state reports which comprise the bulk of the 1953 S-10 Report has been prepared by state project personnel and summarizes in some detail the progress and research results at the various stations. Much of the raw data included is preliminary and, therefore, is not for general publication.

Detailed annual reports of this type have been prepared each year since 1950 for the purpose of familiarizing research workers, administrators, and other interested persons with the progress of the work.

Objectives

As given in previous reports, the objectives of this research are:

1. To develop breeding methods, selection criteria, and procedures which will result in beef cattle capable of higher productive efficiency and superior market qualities of product.

2. To develop beef cattle with higher reproductive efficiency, greater longevity and other aspects of lifetime productive efficiency.

3. To develop beef cattle especially adapted to conditions in various environments of the Region.

4. To explore the usefulness of systems of breeding, as:

   (a) Inbreeding
   (b) Crossbreeding
   (c) Outbreeding
   (d) Combinations of these to accomplish objectives 1,2, and 3.

5. To study productiveness of existing or introduced stocks of beef cattle.

The regional project has been developed along broad lines to study problems in the long-neglected field of beef cattle breeding. In pursuance of the above objectives, the work in general resolves itself into four phases, which are: (1) Development of measurement methods and selection criteria, (2) Estimating the heritability of characters of productive importance in beef cattle, (3) Assessment of the productive value of cattle from various sources and of different breeds or types, and (4) Comparisons of different breeding systems. The first two of these phases have to do with developing methods for assessing the productivity of beef cattle and with utilizing heritability estimates of various traits in conjunction with economic importance in determining the relative importance various factors should have in selection programs. The last two phases have to do with the utilization of criteria developed to date for the evaluation of cattle of different strains or breeds or those produced by different breeding methods.

Scope of Work

According to inventory figures submitted July 1, 1953, there were 3,590 females of breeding age (2 years old or older) in use in the project. This figure probably gives the best available picture of project size, although the figures of 790 yearling heifers, 247 bulls, and 2,359 calves under one year are also indicative of project activity. It should be noted, however, that in some cases these animals are also used for other purposes, thus lessening somewhat their usefulness for this project. During the winter 1952-53, 515 bulls, 256 steers and 572 heifers were fed under performance testing conditions. In addition, growth records and periodic type scores are kept on all replacement heifers whether on dry-lot performance trials or not.

One new project was added during the year. The Mississippi station initiated a project during the year which will involve progeny testing of bulls from different inbred lines and outbred strains of beef cattle. This project should be valuable in early years in continuing the search for productive cattle in existing strains. It will become increasingly useful in future years for assessing the value of lines developed at other locations in the project. The inclusion of Mississippi as an active participant makes a total of twelve state experiment stations cooperating in the regional project. The three U. S. Department of Agriculture beef cattle stations located at Brooksville, Florida; Front Royal, Virginia; and Jeanerette, Louisiana are also a part of the regional project and are in each case operated in cooperation with the state experiment station in the state where located.

Progress During The Year

The individual state reports give details on technical accomplishments, development of physical facilities and acquisition of cattle.

All stations have been keeping detailed weight records and body type scores on all growing cattle since the inception of the project. Several stations have been keeping detailed body measurement records, and carcass information on animals slaughtered has been obtained in as great detail as facilities permit. As will be seen from the state reports, the majority of stations are making use of these accumulated records in specific studies. Where only one station is involved in a study, results are given in the report of the station involved and will not be reviewed here.

In several instances during the past year, two or more stations have analyzed data on similar problems, or unpublished data from several stations have been made available for summarization by one worker. Details on these instances follow:

1. Estimates of the heritability of ability to gain based on sire offspring regressions at the Virginia station have thus far averaged 22 percent for steers in the feedlot and 15 percent for grazing heifers. Estimates of feedlot gaining ability from half-sib correlations at the Texas station based on considerably larger numbers (853 head) have been 38 percent and for 587 head all raised

on the Bluebonnet Farm have been 34 percent. Parent offspring regression on 81 pairs gave an estimate of 57 percent. The estimates from these stations are probably illustrative of the fact that different populations vary in the amount of genetic diversity. Sampling errors may also well be involved. In any event, selection for ability to gain should be effective.

2. Relationships of live animal measurements to type scores assigned on the basis of visual appraisal were studied at the Arkansas and Tennessee stations by use of multiple correlation and regression techniques. Results indicated relatively low relationships with 42 to 85 percent of the variance in type scores remaining after taking out all that could be accounted for on the basis of the measurements. Data from the Front Royal, Virginia station suggest a reasonably high relationship between type scores and the ratio $\frac{\text{depth of chest}}{\text{height at crops}}$. Data from the same station indicate a very low predictive value of birth measurements and scores on later performance.

3. Repeatability of weaning weights of calves from different cows has been studied further at the Tennessee, Florida, Georgia and Arkansas stations. These studies (as summarized together with previously published material by Koger of Florida) indicate some variation in repeatability from herd to herd but values were positive in all except one herd (a privately owned one) where management was known to have lacked uniformity. This indicates that low producing cows can be safely culled from a herd.

4. A summary by Smith of Tennessee on the effects of sex of calf and age of dam on weaning weights of calves showed considerable variation from station to station but no definite evidence of breed differences. Bulls averaged approximately 37 pounds and steers 24 pounds heavier than heifers. Calves weaned from cows 6 to 8 years of age were 41 to 76 pounds heavier in different herds than those weaned from 3-year-old cows. Adjustments need to be made for the effects of sex and age of dam in evaluating weaning weights.

5. Comparisons of the weanling and maternal performance of Brahman crossbred animals as compared with British types continued at the Georgia, Florida, North Carolina, Texas and South Carolina stations with results generally in line with previous years, although at the Texas and Georgia stations the feedlot gains of crossbreds were relatively lower than in many studies. At the South Carolina station both Brahman crosses and crosses between British breeds again outperformed purebred British calves at weaning. This trend has been so consistent for several years as to strongly suggest the need for more crossbreeding work with British cattle. An analysis of calf weaning weights from cows of various breeding accumulated at the Ona, Florida station over a period of several years ranked the cows in the following ascending order: native, British, over half Brahman, less than half Brahman, and half Brahman.

Cooperative studies of data can be expected to increase in future years -- thus fulfilling the basic purpose of regional research.

S-10 Problems

As pointed out in previous annual reports, the various stations involved in the Southern Beef Cattle Breeding Research Project have made truly remarkable progress in assembling breeding herds, making use of existing herds and acquiring facilities for beef cattle breeding research. These things have been accomplished in spite of limited financial support at most stations. Much remains to be done in these regards, but our project has probably now progressed to the point where the most important problems facing us are those of a technical nature rather than those of a physical nature which were unavoidably most pressing during the early years.

The annual meeting of the Technical Committee was held late in the summer at Knoxville, Tennessee, with the theme of the meeting being, "Live Animal and Carcass Evaluation". This meeting at which most pertinent research data now available were reviewed, tended to point up what is probably the most important problem facing us, namely, the nature and importance of hereditary variations in carcass quality and their relationship to the external appearance and measurements of beef animals. Data accumulated to date, particularly at the Texas and Maryland stations, are somewhat at variance with customary viewpoints in that hereditary differences in carcass quality have tended to be small or non-existent and carcass cut-out values have not been highly related to external body measurements. The Knoxville meeting, bringing together as it did all the available information, served to point up the importance of the problem. It may well be that expanded research work on this question is the most important problem now facing the S-10 Project as well as beef cattle breeding projects in other areas.

Due to limited finances, we have as yet made but limited progress on one of the principal objectives, namely, that of evaluation of various stocks of beef cattle, both those commonly used in the United States and those which may be introduced. During the past year the Louisiana station made a start in this regard by conducting tests involving the Brahman-Angus strain developed during recent years at the Jeanerette, Louisiana Experiment Station and the Charolaise breed both in comparison with standard breeds and crosses. The crossbred Romo-Sinuano cows produced a few years ago at the North Carolina station with semen flown in from Colombia, South America are now in production and their calves have shown excellent weight but have been below average in type according to accepted standards. This phase of the work shows sufficient promise that it should be prosecuted as vigorously as funds and facilities will permit.

The problem of dwarfism continues to plague certain projects with dwarf calves having been produced at two additional stations during 1953. It is probable that two or more stations will initiate specific research projects on this subject in the near future.

The drop in cattle prices has tended to squeeze some stations that are dependent in large part upon receipts for financing research efforts.

PERSONNEL of the S-10 PROJECT

STATE AGRICULTURAL EXPERIMENT STATION WORKERS
(asterick indicates Tech. Committee Members)

Alabama	*Keith E. Gregory, W. D. Salmon	Auburn, Ala.
Arkansas	*Warren Gifford, Martin Burris	Fayetteville, Ark.
Florida	*Marvin Koger, A. C. Warnick	Gainesville, Fla.
	W. G. Kirk	Ona, Fla.
Georgia	*B. L. Southwell, W. C. McCormick	Tifton, Ga.
	Walter Neville	Experiment, Ga.
Louisiana	*Richard A. Damon, Jr.	Baton Rouge, La.
Maryland	*J. E. Foster, W. W. Green	College Park, Md.
Mississippi	*C. E. Lindley, L. C. Ulberg	State College, Miss.
North Carolina	*H. A. Stewart, E. U. Dillard	Raleigh, N. C.
South Carolina	*E. G. Godbey	Clemson, S. C.
Tennessee	*Charles S. Hobbs, H. J. Smith, R. P. Moorman	Knoxville, Tenn.
Texas	*Bruce L. Warwick, T. C. Cartwright	McGregor, Tex.
	R. E. Patterson, H. O. Kunkel	College Station, Tex.
	J. J. Bayles	Balmorhea, Tex.
	L. A. Maddox, Jr.	Panhandle, Tex.
Virginia	*C. M. Kincaid, R. C. Carter, J. S. Copenhaver, Frank S. McClaugherty	Blacksburg, Va.
	R. L. Arthaud, J. C. Taylor	Front Royal, Va.
	Roy Hammes	Middleburg, Va.

U. S. DEPARTMENT OF AGRICULTURE WORKERS

R. T. Clark, Nat'l Coordinator, Beef Cattle Research, Denver, Colo.
Everett J. Warwick, Regional Coordinator, S-10, Knoxville, Tenn.
E. H. Vernon, Supt., Iberia Livestock Experiment Farm, Jeanerette, La.
B. M. Priode, Supt., Beef Cattle Research Station, Front Royal, Va.
M. W. Hazen, Acting in Charge, Chinsegut Hill Sanctuary, Brooksville, Fla.

REGIONAL OFFICERS

R. E. Patterson, Administrative Advisor, College Station, Tex.
Charles S. Hobbs, Chairman, Knoxville, Tenn.
Marvin Koger, Secretary, Gainesville, Fla.
Bruce L. Warwick, Executive Committee Member, McGregor, Tex.

ALABAMA STATION

Submitted by Keith E. Gregory, December, 1953

1. Project Title: (Alab. 525) Improvement of Performance of Beef Cattle Through Mass Selection.

2. Objectives:

   (a) To determine the effectiveness of mass selection for total performance in beef cattle.

   (b) To develop criteria for evaluating and selecting breeding animals.

3. Accomplishments during year:

   (a) Acquisition of cattle: Three Aberdeen-Angus bulls and three Hereford bulls were secured during the year for use on the project.

   (b) Improvement of facilities: Two feeding sheds that will take care of an additional thirty-two animals on post weaning performance tests were added during the year.

   (c) Research results: The first calf crops in the Angus and Hereford lines were born during the year. Data collected to date on these calves include birth weight, weaning weight and weaning score. These calves are now on 154-day performance test to get information on post weaning gains.

   The 154-day post weaning performance test was completed on 46 bulls (30 Hereford, 16 Angus) during 1953. Sixty-eight bulls and eighteen heifers have already been started on the 1953-54 performance test.

4. Future Plans:

   (a) Improvement of facilities: Reclamation of land and seeding of grazing crops will be continued as rapidly as funds permit.

   (b) Extension of project: As soon as adequate facilities are developed and an adequate number of cattle can be obtained, it is planned to initiate research to determine the influence of heterosis on rate of gain, carcass quality and cow performance. The Aberdeen-Angus, Hereford and Shorthorn breeds will be used in this study. During 1954, it is planned to initiate a breeding project with laboratory animals as a supplement to Regional Project S-10 to study methods of selection more extensively.

PERFORMANCE OF COW HERDS. 1952 FALL CALVES

Line or group designation	Angus	Hereford
Location	Auburn	Auburn
Breed of sire	Angus	Hereford
Breed of dam	Angus	Hereford
No. cows bred*	18	18
No. cows calving*	18	13
No. calves raised	15	13
Av. inbr. of dams (%)	Outbred herds	
Av. inbr. of calves (%)		
Av. birth wt. (lbs.)	58	62
Av. birth date	11/11/52	11/5/52
Were calves creep fed?	No	No
Av. weaning date	7/19/53	7/13/53
Av. weaning wt. (lbs. at 250 days)	534	434
Av. weaning type score**	13.2	12.1
Av. weaning condition score**	13.2	12.1

* All first calf heifers.
** 6-8 = Medium; 9-11 = Good; 12-14 = Choice.

POSTWEANING PERFORMANCE OF 1952 BULL CALVES FULL FED AFTER WEANING*

Group designation	Angus	Hereford
Location	Auburn	Auburn
No. bulls tested	16**	30***
Av. initial age (days)	316(258-367)	308(232-365)
Av. initial wt. (lbs.)	598(498-778)	635(445-965)
Av. daily gain (lbs.)	2.27(1.76-3.09)	2.39(1.48-3.18)

* All bulls were self-fed a mixed ration of 25% ground shelled corn, 20% ground oats, 10% cottonseed meal, 10% molasses, 20% ground alfalfa hay, and 15% cottonseed hulls for a 154-day period.

Animals were group fed and on the average 884 lbs. of the mixture were required per cwt. gain.

** 12 owned by cooperating breeders and 4 by Alabama Polytechnic Institute.

*** 25 owned by cooperating breeders and 5 by Alabama Polytechnic Institute.

ARKANSAS STATION

Submitted by Warren Gifford and Martin Burris, December 30, 1953

Introduction

All animals in the Arkansas project are purebred, and are managed as such. Angus, Hereford, and Shorthorn cattle at the Main Experiment Station are managed as a single herd. A herd of Angus is maintained at the Livestock and Forestry Station.

Approximately one half of the females were pasture bred and the remainder were hand bred. Calves were dropped during all months except the summer months. All calves are weaned at eight months of age. Bull and steer calves not used in progeny feeding trials are sold at weaning or shortly thereafter. All females are kept for replacements and after weaning are pastured or group fed to make acceptable growth. These heifer groups are made up according to age without regard to sire or breed.

1. Project Title: The Determination of Adequate Records of Performance Tests for Beef Cattle.

2. Objectives:

To develop practical but adequate methods for evaluating the breeding worth of beef sires and dams which would include the following:

(a) A system of measuring variations in young animals and the values of such measures in predicting variations in the same animals at more mature ages.

(b) Methods for measuring and evaluating the records of performance of brood cows.

(c) The determination of the kind of records and number of progeny necessary to prove beef sires.

3. Accomplishments during year:

(a) During the year December 1, 1952 to December 1, 1953, the following cattle and facilities have been acquired for use in the Arkansas beef cattle breeding project:

One Angus sire, McLeanmere 666812, was purchased as a replacement herd sire at the Livestock and Forestry Station. Three performance tested Angus sires and one performance tested Hereford sire were kept for sire replacements at the Main Station. In addition, the six-year-old Angus sire, Prince Barman 47th. 1132534, was leased for a period of six months.

Fifty Angus, thirty-nine Hereford and six Shorthorn heifers at the Main Station and twenty-four Angus heifers at the Livestock and Forestry Station, born since December 1, 1951, have been kept in the herds for replacement and increase in cow numbers.

Due to the severe drought conditions that have prevailed during the year, the pasture improvement and fence building programs have been curtailed. Approximately fifty acres of pastures have been improved on the Main Station and a similar area on the Livestock and Forestry Station for use of this project. Approximately five miles of permanent fence have been built.

(b) The following research has been completed or is in progress:

Milk production records were obtained for seventeen Angus, five Herefords, and three Shorthorn cows with the subsequent growth records on their calves.

Twenty-one bulls were fed individually for 154 days to obtain measures of performance.

All animals were classified according to subjective type score.

Growth records, as indicated by weights and body measurements, were recorded on all young and mature animals.

The study of subjective evaluation data recorded on all animals in the project between 1940 and 1950 was completed and a manuscript reporting results was prepared for publication.

Relationships between score and live animal measurements have been calculated.

Records of cow performance during a twelve-year period have been analyzed to determine the repeatabilities of weaning weight of calf, weaning score of calf, cow weight, cow score and calving interval.

4. Future Plans:

Continuation of studies of milk production in beef cattle.

Continuation of individual feeding of bull progeny of sires and the feeding of steer and heifer groups when possible.

Study differences in rate and efficiency of gain of performance tested bulls in terms of their ability to digest the test ration.

Continuation of study of growth and development of all animals.

Continuation of classification study.

Continuation of the long-time program of developing lines within the herds.

5. Publications:

Brown, C. J., Warren Gifford and Maurice L. Ray. A Subjective Method for Evaluating Conformation of Beef Cattle. Permanency and Accuracy of Conformation Scores. Ark. Agric. Expt. Sta. Bull. 540, 1953.

Arkansas Station (continued)

Leuker, Carl E. Factors Affecting Beef Cow Performance. Thesis, University of Arkansas Library, 1953.

Weir, Leslie B. The Influence of Rainfall, Temperature and Humidity on the Feed Consumption, Gains and Efficiency of Beef Cattle. Thesis, University of Arkansas Library, 1953.

Brown, C. J. The Relationship Between Score and Live Animal Measurements. Paper presented at annual meeting of S-10 Technical Committee, Knoxville, Tennessee, 1953.

POSTWEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING

Arkansas Station

Line or group designation	Alford's Pr. Eric 943326	K.Eileenmere 2 1316264	Greenhill Duke	Bar Pr. 2 of Sun Ray 1062761	Flying L. Anxiety 1st 3840914	Nobleman 5th X 2554929
Location	Main Station	Batesville	Main Station	Main Station	Main Station	Main Station
Breeding of calves	Angus	Angus	Hereford	Angus	Hereford	Shorthorn
Bulls, No.	6(6)*	5(4)	4(2)	1(0)	3(1)	1(0)
Av. inbreeding (%)	1.5		0.0	1.5	0.0	0.0
Av. weaning wt.	493	509	434	365	500	490
Av. 12 month wt.	711	718	608		824	
Length of feeding period	154	154	154		154	
Feed per cwt. gain (lbs.)	827	886	800		881	
Concentrates	551	591	533		587	
Roughage	275	295	267		294	
Av. daily gain on test	2.22	2.06	2.16		1.97	
Av. type score (12 mo.) **	72	71	70		71	

* Parentheses indicate number of animals which have finished test by December 15, 1953.
** All Arkansas scores according to a scale with top possible score 100.

PERFORMANCE OF COW HERDS. 1953 CALVES

Arkansas Station

Line or group designation	Black Pr. B of UArk. 11	Bar Prince 2 of Sun Ray	Alford's Pr. Eric	Pr. Eric of UArk 195	K.Eileenmere 2"	Eileenmere F 80"	Bl'cap Eileenmere 299"
Location	Main Sta.	Main Sta.	Main Sta.	Main Sta.	Batesville	Batesville	Batesville
Breed of sire	Angus	Angus	Angus	Angus	Angus	Angus	Angus
Breed of dam	Angus	Angus	Angus	Angus	Angus	Angus	Angus
No. cows bred	Pasture	Pasture	42	8	15	25	2
No. cows calving*	40	2	13	2	14	21	3
No. calves raised	39	2	13	2	14	20	3
Av. inbr. of dams (%)	2.7	1.6	0.1	2.0			
Av. inbr. of calves (%)	3.3	3.1	3.0	10.4			
Av. birth wt. (lbs.)					54	50	64
Av. birth date (Spring Calves)	3-23-53	6-21-53	4-1-53	1-13-53	3-1-53	3-13-53	1-26-53
(Fall Calves)	10-24-53	9-26-53	10-21-53	10-4-53	9-28-53	9-20-53	None
Were calves creep fed?	only fall calves	only fall calves	only fall calves	only fall calves	No	No	No
Av. wt. 6 mo. (lbs.) **	341(26)		299(10)	298(7)	326(spring calves)	343(spring calves)	410(spring calves)
Av. weaning date (Spring calves)	12-14-53		11-22-53	9-5-53	All weaned	All weaned	All weaned
(Fall calves)	6-16-53	5-19-53	6-13-53	5-27-53	at 8 mo.	at 8 mo.	at 8 mo.
Av. weaning wt. **	430(23)		354(7)	404(7)	430	409	464
Av. weaning type score**	68(23)		63(7)	63(7)			
Av. weaning cond. score **	67(23)		65(7)	65(7)			

* During period December 1, 1952 to December 1, 1953.

** Parentheses refer to numbers of calves weighed or scored and in some cases include 1952 fall calves reaching the specified ages during the period December 1, 1952 to December 1, 1953. All scores on scale with 100 as top possible score.

PERFORMANCE OF COW HERDS. 1953 CALVES

Arkansas Station

Line or group designation	Flying L. Anxiety 1st	CK Creator 13	WHR Helmsman 8	Greenhill Duke	Nobleman 5th
Location	Main Sta.	Main Sta.	Main Sta.	Main Sta.	Main Sta.
Breed of sire	Hereford	Hereford	Hereford	Hereford	Shorthorn
Breed of dam	Hereford	Hereford	Hereford	Hereford	Shorthorn
No. cows bred	17	5	9	12	5
No. cows calving*	21	4	13	7	4
No. calves raised	21	4	10	6	4
Av. inbr. of dams (5)	2.4	0	0.3	0	0
Av. inbr. of calves (%)	2.0	8.7	0.4	0	0
Av. birth wt. (lbs.)					
Av. birth date Spring	2-23-53	6-21-53	4-1-53	1-13-53	5-17-53
Av. birth date Fall	10-24-53	9-26-53	10-21-53	10-4-53	10-19-53
Were calves creep fed?		Only fall calves creep fed			
Av. wt. 6 mo. (lbs.) **	341 (26)		299 (10)	298 (7)	339 (4)
Av. weaning date Spring	12-14-53		11-22-53	9-5-53	6-15-53
Av. weaning date Fall	6-16-53	5-19-53	6-13-53	5-27-53	
Av. weaning wt.**	430 (23)		354 (7)	404 (7)	460 (2)
Av. weaning type score**	68 (23)		63 (7)	63 (7)	81 (2)
Av. weaning cond. score**	67 (23)		65 (7)	65 (7)	78 (2)

* During period December 1, 1952 to December 1, 1953.

** Parentheses refer to numbers of calves weighed or scored and in some cases include 1952 fall calves reaching the specified ages during the period December 1, 1952 to December 1, 1953. All scores on scale with 100 as top possible score.

FLORIDA STATION

Submitted by Marvin Koger, January 9, 1954

1. Project Titles: Beef cattle breeding work in Florida includes the following four projects at the locations indicated:

   No. 390. Breeding Beef Cattle for Adaptation to Florida (Range Cattle Station, Ona).

   No. 615. Influence of Breed Composition and Level of Nutrition on Adaptability of Cattle to Central Florida Conditions (Range Cattle Station, Ona).

   No. 627. Pasture Programs and Breeding Systems for Beef Production on Flatwoods Soils of Central and North Central Florida. (Beef Research Unit, Gainesville).

   No. 629. Selection of Cattle for Beef Production in Southeastern United States (West Central Florida Station, Brooksville, cooperative with U. S. Department of Agriculture).

2. Objectives:

   (a) To determine the value of different classes and strains of cattle for foundation animals and commercial production.

   (b) To test the performance of different breeds and crosses in different breeding systems and to determine if the combining ability of breeds used for crossbreeding can be improved by cross progeny testing.

   (c) To determine the relative productivity of cows with different proportions of English and Brahman blood when run under pasture programs designed to supply low, medium, and good nutrition levels.

   (d) To evaluate the influence of pasture programs and breeding plans on beef productions with a cow-calf operation.

3. Accomplishments during year:

   (a) Additional pasture developed:

   100 acres of Beef Research Unit, Gainesville.
   Remainder of 300 acres cleared at Brooksville and 100 acres planted.
   Irrigation system installed at Range Cattle Station, Ona.

   (b) Cattle acquired:

   Fifty females added to Beef Research Unit.
   Thirty females and one bull added at Brooksville.
   Fifteen grade Shorthorns added at Range Cattle Station.

(c) Personnel added:

Reproduction Physiologist.
Assistant Manager, Beef Research Unit.
Graduate Assistant.

(d) New work started:

Preliminary study started on causes of reproductive failure in Florida cattle and on normal reproductive phenomenon of various breeds and crosses of cattle in Florida.

Study of carcass characteristics of various breeds and crosses begun.

4. Future Plans:

(a) Further increase numbers of cattle to bring planned members of full strength at Ona and Brooksville.

(b) Submit project on reproduction for inclusion in S-10.

(c) Continued pursuit of project outlines as prepared.

(d) Enlarge study on carcass studies on various breeds of crosses.

(e) Initiate study on type and size on purebred herd at Gainesville.

(f) Rewrite Belle Glade Project for inclusion in S-10.

5. Publications:

Peacock, F. M., W. G. Kirk and M. Koger. Effect of Breeding of Dam on Weaning Weight of Range Calves. Jour. An. Sci. 12: 896-897, 1953 (abs).

Pearson, A. M., M. Koger, W. G. Kirk, D. H. Kropf, R. B. Sleeth and J. F. Hentges. A Comparison of Certain Carcass Characteristics of Brahman Versus British Breeds of Steers. Jour. An. Sci. 12: 897, 1953 (abs.).

6. Publications Planned:

Preliminary report on causes of reproductive failure in Florida cattle.

PERFORMANCE OF COW HERDS. 1953 CALVES

Line or group designation	Florida Station								
Location	(- - - - - - - - Gainesville - - - - - - - - - -)					Brah.	Brangus	Heref.	Red Poll
Breed of sire	Brah.	Heref.	S'horn	Angus	Angus	(- - - - - - - Brooksville - - - - -) Brah.	Brangus	Heref.	Red Poll
Breed of dam	Gr.Brah.	Gr.Brah.	Gr.Brah.	Gr.Brah.	Gr. Brah.	Brah.	Brangus	Heref.	Red Poll
No. cows bred ***	97 cows bred in same pasture to bulls of 4 breeds					16	32	9**	19
No. cows calving	12	16	10	13	15*	12	22	9	6
No. calves raised	12	15	9	13	14	12	22	8	6
Av. birth wt. (lbs.)	59	62	57	-	63	57	54	68	66
Av. birth date	3/21/53	3/15/53	3/10/53	12/18/52	4/15/53	2/5/53	2/26/53	3/27/53	3/29/53
Were calves creep fed?	No	No	No	No	No	No	No	No	No
Av. wt. 6 mc. (lbs.)	295	311	320	366	296	338	364	310	361
Av. weaning date	10/12/53	10/12/53	10/12/53	8/31/53	10/12/53	8/30/53	9/17/53	10/5/53	9/29/53
Av. weaning wt.	308	339	356	431	306	403	418	312	408
Av. weaning type score ****	7.9	9.7	8.7	9.5	9.0	9.3	9.5	10.8	7.7
Av. wean. cond. score *****	7.3	10.3	8.4	10.3	7.8	9.2	9.9	8.0	8.5

* An additional cow was pregnant but was slaughtered before term.
** 2 bred at Brooksville, 2 at Gainesville, 5 at Jones Ranch.
*** In addition to the cow numbers given, 24 Santa Gertrudis and crossbred females were bred to a Santa Gertrudis bull who proved to be completely sterile.
**** 6-8 = Med., 9-11 = Good; 12-14 = Choice

PERFORMANCE OF COW HERDS 1953 CALVES

Range Cattle Station, Ona
Florida Station

Breed of sire	Shorthorn	Shorthorn	Brahman	Shorthorn	Brahman	Brahman	Shorthorn
Breed of dam	3/4Br.1/4Sh.	1/2Sh.1/2Br.	1/2Sh.1/2Br.	Brahman	Brahman	English	Less 1/2Br.
No. cows exposed	4	11	15	18	12	21	6
No. cows calving	3	11	12	11	9	18	5
No. calves raised	3	11	12	10	7	18	5
Av. birth wt.	Estimated to be 65 lbs. for the entire group of calves						
Av. birth date	4-1	2-6	2-21	3-4	1-12	2-19	2-6
Were calves creep fed?	No	No	No	No	No	No	No
Av. wt. 6 mo. (lbs.)	381	401	352	416	331	409	355
Av. weanirg date	10-17	9-16	10-11	9-30	9-12	9-16	9-19
Av. weaning wt.	417	479	435	471	431	463	430
Av. wean. type score*	9	11	10	9	8	9	11
Av. wean. cond. score*	9	11	11	9	8	10	12

* 6-8 = Medium; 9-11 = Good; 12-14 = Choice.

PERFORMANCE OF COW HERDS. 1953 CALVES

Range Cattle Station, Ona
Florida Station

Breed of sire Breed of dam	Brahman Less 1/2Br.	Brahman 1/2 Br.	Brahman More 1/2Br.	Santa Gertr. Less 1/2Br.	Santa Gertr. 1/2 Br.	Santa Gertr. More 1/2Br.
No. cows exposed	8	32	47	5	10	7
No. cows calving	7	29	41	5	9	7
No. calves raised	7	29	40	5	9	7
Av. birth wt.	Estimated to be 65 lbs. for the entire group of calves					
Av. birth date	2-26	3-4	3-2	3-29	3-14	2-17
Were calves creep fed?	No	No	No	No	No	No
Av. wt. 6 mo. (lbs.)	363	366	336	327	388	330
Av. weaning date	10-8	10-12	10-10	10-19	10-5	10-6
Av. weaning wt.	436	436	400	362	428	401
Av. wean. type score*	9	9	8	8	8	7
Av. wean. cond. score*	9	10	8	8	9	9

* 6-8 = Medium; 9-11 = Good; 12-14 = Choice.

CALVES SLAUGHTERED AT WEANING

Heifers
Slaughter Data - 1953 Calves: No Inbreeding

Breeding	½ Brahman or more
No.	22
Av. age	229 days
Av. wt.	385
Av. sl. grade	9 (Low Good)
Av. dressing percent	58.03 Cold
Av. carcass grade	9 (Low Good)

13 of these calves were of native pasture and the remaining 9 were inferior calves culled from the herd.

POSTWEANING PERFORMANCE OF 1952 STEER CALVES FULL FED AFTER WEANING

Breeding of calves	3/4Sh.1/4Br.	1/2Sh.1/2Br.	3/4Br.1/4Sh.	Purebred Br.
No.	3	4	4	4
Av. inbreeding	None	None	None	None
Av. weaning age	219	250	235	221
Av. weaning wt.	463	521	498	463
Length of feed period (days)	140	140	140	140
Feed per cwt. gain (lbs.)				
Concentrates	534	582	531	503
Roughage	212	200	202	206
Av. daily gain on test	1.87	2.01	2.02	1.94
Av. type score (12 months)	11	10	10	9

PRODUCTION DATA ON YEARLING AND OLDER CATTLE
NOT INCLUDED IN BREEDING HERDS IN 1953

Florida Station
Brooksville

Line or group designation	Brahman	Brangus	Hereford	Red Poll	Santa Gertrudis
Breeding	Brahman	Brangus	Hereford	Red Poll	Santa Gertrudis
Sex	F	F	F	F	F
No.	13	13	19	10	16
Av. age (fall 1952)	439	245	321	316	Unknown
Av. wt. (fall 1952)	572	394	551*	460	379**
Av. winter gain	-60	39	18	37	67
Days on pasture (Average w/o supplement. On pasture entire year)	345	249	257	281	210
Av. gain on pasture w/o supplement	195	215	147	239	247
Days on feed (Pasture with approx. 1½ lbs. CSM as supplement) Average	88	116	64	105	85
Av. gain on feed (Pasture w/ supplement)	6.8	30.4	-4.6	4.4	55

* Weight shown average weight on Jan. 19, 1953 (first weight obtained after arrival here)
** " " " " " Dec. 10, 1952 (" " " " " "))

GEORGIA STATION

Submitted by B. L. Southwell, December 30, 1953

1. Project Title: The Improvement of Beef Cattle in Georgia Through the Use of Selection for Economic Factors Brought Out in the Process of Inbreeding, Crossbreeding, and Outbreeding.

2. Objectives:

(a) Sire testing studies with Polled Hereford and Angus cattle.

(b) The value of the Brahman breed in developing cattle that are better adapted to the climatic and feed conditions of the Coastal Plain area of the Southeast.

3. Accomplishments during year:

(a) Two Polled Hereford bull calves were purchased in the fall of 1952, fed in performance studies during the fall and winter of 1952-53 and bred to two groups of females in the spring and early summer of 1953.

Ten Polled Hereford heifers were purchased in the fall of 1952, fed in performance studies during the following fall and winter and placed in the breeding herds in the spring of 1953. Their performance will be compared with that of the females produced in the Station herd.

Three Polled Hereford breeders sent 10 bull calves to this Station in the fall of 1953 to be fed in the performance studies. If performance during the feeding period together with type score justifies it, any of these bulls can be purchased and tested in the Station herd. If not purchased, they will be loaned to the Station for one breeding period.

No new equipment was added during the year other than minor items used in regular routine work.

(b) 1. Polled Hereford Sire Testing Studies: Three bulls were proved during the fall and winter 1952-53. All of the offspring were placed in dry lot approximately two weeks after weaning and full-fed for 140 days. At the end of the test period, each calf was rated according to the following formula:

$$\text{Rating} = \text{Type Score} + \frac{\text{Avg. Daily Gain}}{.05}$$

Each sire received a rating equal to the average of his offspring. Type score in above formula accounts for 50 percent and rate of gain 50 percent of the rating.

Georgia Station (continued)

The three Polled Hereford bulls rated as follows:

Sire No. 497 - 87.80
Sire No. 294 - 77.10
Sire No. 1 - 83.34

Sire No. 1 is a son of No. 497. He was brought in from a herd of Polled Herefords on which No. 497 had been used. The cows in this herd were almost entirely of Station breeding.

Two sons of bull No. 497 made average daily gains of above 3 pounds during the 1952-53 feeding period. Two sons of bull No. 1 likewise made average daily gains exceeding 3 pounds daily. One bull purchased in the fall of 1952 made average daily gains of 3.36 pounds which is the highest average daily gain ever made in tests at this Station. This latter bull, however, was two months older than any of the calves that had been previously tested in the herd which contributed somewhat to his higher daily gain.

All calves were fed in groups of approximately 10 or 12 animals. The calves were grouped according to sex and initial weight. All calves were full-fed Coastal Bermuda hay and full-fed a grain mixture composed of:

6 parts cracked shelled corn
1 part cottonseed meal (36 percent protein)

2. Angus: Only one Angus sire was represented in the 1952-53 studies. He received an individual rating of 73.50. His highest gaining son made an average daily gain of 2.81 pounds. The sire proved (Lric Lad of Dwight #319) was a son of No. 500 that had previously been represented in the Angus sire testing studies.

All calves, both Angus and Polled Hereford, were creep fed a grain mixture (the same formula as above) during the suckling period.

Only three calves had previously made average daily gains during the post-weaning feeding period of above 3 pounds until the 1952-53 period when five calves reached that record.

3. Crossbreeding Studies - First-cross Brahman Versus First-cross Angus Calves: The first-cross Brahman and first-cross Angus calves were out of comparable grade Hereford dams. They were creep fed the same grain mixture as were the Polled Hereford and Angus calves. All the steer calves were slaughtered at weaning. Birth weight, slaughter data, etc., are included in attached tables.

Seven first-cross Brahman heifers and nine first-cross Angus heifers were fed in the sire testing study group. They were fed the same grain mixture and handled in exactly the same manner as the purebred bull and heifer groups. The first-cross Brahman heifers made average daily gains during the feed lot period of 1.78 pounds and received an individual rating average of 71.26. The nine first-cross Angus heifers made an average daily gain of 1.98 pounds or .2 pound more than did the first-cross Brahman. The Angus heifers received an individual rating average of 79.90. Neither group of crossbred heifers made as good average daily gains as did the Polled Hereford heifers.

Eleven out of 12 first-cross Angus heifers and nine out of 12 first-cross Brahman heifers calved in the spring of 1953. Both groups of calves were sired by a Polled Hereford bull. Attached tables show that the calves out of the first-cross Brahman cows averaged 4 pounds heavier at birth and 67 pounds heavier at weaning than did the calves from the first-cross Angus dams.

4. Future Plans:

Sire testing studies with Polled Herefords will be continued. From 50 to 60 cows will be maintained in this study enabling us to prove three bulls each year. A herd of from 15 to 20 cows was set up in the spring of 1953 where the selection criteria will be based primarily on weaned weight of calves. Another herd of approximately 15 to 20 females was set up in the breeding group where the selection criteria will be largely rate of gain in feed lot during the 140-day post-weaning dry lot feeding period. A third breeding group will be set up in the spring of 1954 where the selection criteria will be based on type. This will round out our performance studies with Polled Herefords. At least one and possibly two Polled Hereford bulls rating high in type and conformation will be acquired to head the new breeding group added in 1954.

The Angus herd will be maintained as a two-sire group with a total of 30 to 40 brood cows.

The study comparing first-cross Brahman and first-cross Angus calf production was discarded in 1953. The first-cross heifers produced in this study will be maintained in an effort to determine the comparative value of the two crosses in breeding performance.

5. Publications:

Annual Reports to the Georgia Coastal Plain Experiment Station, to the Regional Director of Southern Beef Cattle Breeding Projects, and to the Bureau of Animal Industry, U.S.D.A.

6. Publications Planned:

A 17-Year Genetic Study of a Herd of Polled Hereford Cattle by W. C. McCormick.

The following supplement to the Georgia Project, while not strictly a part of the breeding project, is presented for its interest:

Georgia Station (continued)

GRADE BRAHMAN VS. GRADE HEREFORD AND GRADE ANGUS STEERS
Summer Grazing Period - 1952
Winter Fattening on Grass and Limited Grain - 1952-53

Steers of Brahman and others of only European breeding were used in the summer 1952 grazing trials and later in winter fattening studies at this Station. Only those that were on summer grazing for 182 days or more are considered in this comparison. In the Brahman group, seventeen were by Brahman bulls and out of grade Hereford cows, and eight were by Angus bulls and out of $\frac{1}{2}$ Brahman, $\frac{1}{4}$ Hereford, $\frac{1}{4}$ native cows. They were produced on the Range Project. The grade Hereford and Angus steers were purchased locally. All steers went on test as short yearlings weighing about 460 pounds and were sold for slaughter about fourteen months later weighing approximately 920 pounds.

The steers were equally allotted to lowland permanent pasture tests of Dallis grass, carpet grass and white clover and to upland permanent pasture tests of Coastal Bermuda. In both the lowland and upland permanent pasture experiments the effects of rates of nitrogen were being studied. The steers were placed on pasture in early April and carried until late October. They were all thrown together and given slightly less than a maintenance ration until the wintering tests were begun on December 31.

Again the steers were equally divided, but into only six groups, and were carried on an annual winter pasture of Abruzzi rye and crimson clover. One group was fed no grain, one group was full fed Coastal Bermuda hay, and three groups received limited grain. One group was full fed grain in dry lot for 35 days after the grazing period ended.

The steers sired by the Brahman bulls and out of grade Hereford cows made an average daily gain during the summer grazing period of 1.17 pounds, as compared to 1.16 pounds made by the steers sired by Angus bulls and out of $\frac{1}{2}$ Brahman cows. The grade Hereford and Angus steers in the same grazing lots with the steers of Brahman breeding made an average daily gain of .756 pound or .414 pound less than the steers of Brahman breeding.

The steers by Brahman bulls and out of grade Hereford cows made an average daily gain of 2.22 pounds during the winter fattening trials as compared to 2.13 pounds made by the steers sired by Angus bulls out of grade Brahman cows. Grade Hereford and grade Angus steers in the same lots during the winter fattening period made an average daily gain of 2.52 pounds or .33 pound more than the steers of Brahman breeding. On the average there was little difference in the feeder and slaughter steer grades of the entire group, the average grade in both cases being Good minus. On the average the steers of Brahman breeding graded slightly higher in the carcass. The dressing percent of the steers with Brahman blood was 58.50 percent which was 2.41 percent more than the average dressing percent of 56.09 shown by the grade Hereford and Angus steers.

POST WEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING

Georgia Station
Coastal Plain Station, Tifton

Line or group designation	Sire Testing				Crossbreeding	
Breeding of calves	Polled Hereford			Angus	Br. x Gr.Here.	Ang. x Gr.Here.
Sire of calves**	#497	#294	#1	#319		
Bulls, No.	9	4	7	13		
Av. weaning wt.	475	480	446	452		
Av. 12 month wt.	885	846	843	790		
Days	(378)	(380)	(373)	(375)		
Length of feeding period	140	140	140	140		
Av. daily gain on test	2.68	2.37	2.62	2.10		
Av. type score (12 mo.) *	75	82	74	73		
Heifers, No.	4	10	7	11	7	9
Av. weaning wt.	456	433	436	372	482	482
Av. 12 month wt.	778	736	701	612	731	770
Days	(378)	(386)	(372)	(375)	(365)	(374)
Length of feeding period	140	140	140	140	140	140
Av. daily gain on test	2.50	2.03	2.01	1.82	1.78	1.98
Av. type score (12 mo.) *	76	73	74	74	74	79

*Based on scale with 100 as top possible score.

**Names of sires: No. 497 ALF Beau Rollo 56th
No. 294 Coastal Sir Perf. 26"
No. 1 Ly's Beau Rollo 1
No. 319 Eric Lad of Dwight

PERFORMANCE OF COW HERDS. 1953 CALVES

Georgia Station
Coastal Plain Station, Tifton

Line or group designation	Sire Testing		Crossbreeding		
Breed of sire	P.Heref.	Angus	Angus	P.Heref.	P.Heref.
Breed of dam	P.Heref.	Angus	Gr.Heref.	½ Ang. x ½ Gr.Here	½ Br. x ½ Gr.Here.
No. cows bred	69	38	34	12*	12*
No. cows calving	62	33	33	11	9
No. calves raised	56	31	31	10	9
Av. birth wt. (lbs.)	70	72	69	61	65
Av. birth date	Feb. 20	Feb. 28	Feb. 11	Feb. 14	Feb. 8
Were calves creep fed?	Yes	Yes	Yes	Yes	Yes
Av. wt. 6 mo. (lbs.)	340 (8-19-53)	389 (8-27-53)	424 (8-10-53)	348 (8-13-53)	412 (8-7-53)
Av. weaning date	9-15-53	9-16-53	9-15-53	9-15-53	9-15-53
Av. weaning weight	388	419	470	401	468
Av. wean. type score	Ch-	Ch-	Ch-	Fancy-	Ch-
Av. wean. cond. score	G+	Ch-	Ch-	Ch-	Ch-
Calves slaughtered at weaning:					
1. Steer calves					
No.			7	3	1
Av. age (days)			197	224	216
Av. wt.			445	465	525
Av. slaughter grade			G+	Ch+	Ch
Av. dressing percent			56.7	58.4	54.2
Av. carcass grade			G+	G	G-
2. Heifer calves					
No.			14	7	8
Av. age (days)			217	208	219
Av. wt.			443	374	461
Av. slaughter grade			Ch-	G+	Ch-
Av. dressing percent			58.5	57.0	57.0
Av. carcass grade			Ch-	G-	G

* All two- and three-year-old heifers.

LOUISIANA STATION

Submitted by R. A. Damon, Jr., December 30, 1953

Beef cattle breeding research is carried on at Baton Rouge and Jeanerette in Louisiana. At the state station at Baton Rouge, different breeds and strains of cattle are being compared. The United States Department of Agriculture station at Jeanerette is operated cooperatively and is devoted primarily to the development and testing of new strains of cattle. The Brahman-Angus strain developed at Jeanerette is one of those under test at Baton Rouge. The project at each station is considered separately in the material which follows:

1. Project Title: The Improvement of Beef Cattle for the Southern Region Through Breeding Methods. (Baton Rouge)

2. Objectives:

   (a) To develop types of beef cattle best suited to conditions along the Gulf Coast.

   (b) To compare the performance of several breeds of beef cattle and crosses between these breeds with respect to rate of growth on pasture, fattening ability, and meat quality of steers.

   (c) To estimate the amount of hybrid vigor that can be expected to result from crossing beef breeds and to ascertain the methods best suited for its utilization and maintenance.

3. Accomplishments during year:

   (a) Twelve crossbred steers, remaining from the breeding program followed before the present project was initiated, were fed out in dry lot for a period of 154 days. The steers were slaughtered and appraised in the University's meat laboratory. The results of this work are presented in the accompanying tables.

   (b) One hundred and eighteen calves were produced from the breeding program as described in the 1952 Annual Report of S-10. Six herds of thirty-two cows each were formed, and each of these herds was bred to a bull of a different breed. Each breeding herd consisted of eight Hereford, eight Angus, eight Brahman, and eight Brahman-Angus cows. The bulls used were of Angus, Brahman, Brahman-Angus, Charolaise, Hereford and Shorthorn breeding. The data, through the weaning period, resulting from this program are presented in the accompanying tables.

   (c) The same breeding plan as described in (b) above, was carried out in the spring of 1953, the breeding season extending from April 15, 1953 to July 15, 1953. A different bull was used to represent each of the six breeds and the cow herds were rotated to bulls of different breeds.

Louisiana Station (continued)

(d) The 63 heifer calves produced in the 1953 calf crop are being utilized in a pasture project being conducted at this station. They will be used on this project for one year and then will be retained for future breeding use in the crossbreeding project.

(e) The 55 steer calves produced in the 1953 calf crop are being fattened on wheat pasture with a concentrate supplement. The steers will be fed on this for 154 days. At the end of that period they will be slaughtered in the University's meat laboratory and complete carcass data will be gathered to supplement the information necessary for evaluation of the different breed groups.

(f) In a study of the inheritance and effects of the gene for muscular hypertrophy or "double-muscling" in cattle, five Africander-Angus heifers were bred to an Africander-Angus bull. Two of the heifers and the bull are "double-muscled" animals while the other three heifers are normal in appearance. All five heifers have been pronounced safely in calf.

(g) The clearing of additional land has continued and approximately 125 acres of land have been cleared. It is planned to clear another 250 acres of land, which is necessary to carry on the project as originally outlined.

(h) A considerable amount of machinery and equipment has been either leased or purchased in order to facilitate the farming operations required in carrying on this project. This equipment includes two tractors, a mowing machine, a rotary pasture clipper, a three-bottom plow, disc harrow, section harrow, seeder-cultipacker, and a pasture seeding and fertilizing machine. A Jeep truck has also been purchased.

4. Future Plans:

The breeding program as outlined in the preceding section will be continued for another one or two years, depending on the number of progeny produced. The heifers resulting from this breeding program will be retained and records kept of their development and performance. The steers will be fed out, probably on a combination of winter pasture and concentrate supplement, and slaughtered in the University's meat laboratory.

A second phase of the project will be initiated after three or four crops of crossbred and purebred calves have been produced as described above. In this phase, the crossbred females produced by breed crossing will be bred back to bulls of each of the parental breeds. Purebred animals, which have been produced in the project, will be bred at the same time in order to have within year comparisons between backcross and purebred animals. Two or three years will be devoted to this work.

A third phase will then be conducted in which the crossbred females will be bred to bulls of a third breed. Again, purebred females will be included in the breeding herds.

Matings will continue to be made between Africander-Angus cattle in the study of the "double-muscling" gene.

5. Publications:

Andrews, N. T. Feed-lot Performance of Various Beef Grades and Crosses. A Master's Thesis.

Francioni, J. B. and R. A. Damon, Jr. A Preliminary Study of the Feed Lot Performance of Certain Beef Grades and Crosses, and A Proposed Experimental Plan for Studying Various Beef Breeds and Crosses. (Paper given at 1953 Meeting Assoc. Southern Agricultural Workers.)

6. Publications Planned:

As soon as sufficient data become available, publications will be prepared.

1. Project Title: The Improvement of Beef Cattle for the Southern Region Through Breeding Methods. (Jeanerette)

2. Previous Work:

Breeding investigations have been conducted for more than twenty years, at the Jeanerette Station, in an effort to develop strains of beef cattle particularly adapted to the Gulf Coast Region. It is necessary at this time to develop a plan whereby the progress of this work can be evaluated. One part of the evaluation of these lines of cattle has been instituted by the transfer of 48 head of Brahman-Angus cattle to Baton Rouge for inclusion in the crossbreeding project at that station. As a further step in the examination of the accomplishments of the research work, a tentative research plan for the Jeanerette Station has been drawn up. The tentative plan is summarized below.

3. Purpose of Investigation:

(a) To gather data designed primarily to yield a partial evaluation of the strains of Brahman-Angus and Africander-Angus cattle which have been developed at the Jeanerette Station.

(b) To provide for the propagation and development of these strains of cattle.

4. Method of Procedure:

(a) Brahman-Angus herd: It is proposed that the presently available approximately 80 cows be divided into four lines of approximately 20 cows each which will hereafter be maintained as closed lines. The original division will be at random within sire progeny and age

Louisiana Station (continued)

groups so that the four lines should be comparable initially. It is thought desirable to set up these closed herds in order that if animals of this breeding prove useful in the tests now underway and planned, crosses can be made between the lines with the line cross animals having a lower coefficient of inbreeding than would be attainable if the herd were operated as a single breeding unit.

(b) Africander-Angus herd: The approximately 40 cows of this line now available will be bred in two closed lines, according to the same procedures as outlined for the Brahman-Angus, except that emphasis will be put on the elimination of the gene for "double muscling", now present in high frequency in the line. It is planned to increase the number of cows in this line to at least 60 in the near future.

(c) Brahman herd: Enough additional Brahman cows will be assembled from diverse sources to make a herd of at least 24 breeding females, increasing to 40 head or more as feed supplies permit. The first year after the initiation of this program, half of these should be bred to a Brahman bull and half to an Angus, with the division of cows going to each bull being at random within sire and age groups. In the second and later years, two-thirds of the cows should be bred to a Brahman bull and one-third to an Angus.

(d) Aberdeen-Angus herd: A herd of 24 or more Angus cows should be purchased giving attention to acquiring animals of several different blood lines. They should be carried on in exactly the same manner as the Brahman herd discussed above.

(e) First Cross Females: All the sound Brahman x Angus and Angus x Brahman crossbred heifers should be saved until this group is built up to 24 cows. Subsequently, they should be selected and culled on the same basis as the other herds. They should all be bred to representative bulls selected from the Brahman-Angus lines.

(f) Steer Feeding Procedures: Each year there will be groups of steers available for feeding, representing the several types of breeding involved. These should be put in dry lot at weaning and full fed for approximately 150 to 180 days aiming at a High Good to Low Choice finish. Initially they will be fed ground mixed rations starting with a 1:1 concentrate-roughage ratio and shifting to a 2:1 ratio at the end of the first month on feed.

5. Accomplishments during year:

(a) Breeding: The breeding program as described in section (3) above was followed as closely as possible in 1953. 95 Brahman-Angus cows were divided into four herds and bred to different Brahman-Angus bulls. Two of these herds were considerably larger than the others and will be divided in the 1954 season, resulting in six Brahman-Angus herds. These herds will then be bred as closed lines as described above. 51 Africander-Angus cows were divided into three herds which were bred to different bulls. In the 1954 breeding season these cows will be consolidated into two closed herds. 15 Brahman cows were bred in 1953.

Louisiana Station (continued)

(b) Feeding: Superior bull calves were selected after weaning to be placed in the feed lot for a record of performance study. 12 Brahman-Angus, 5 Africander-Angus and 3 Brahman bulls are now being fed out. In addition to the bulls on feed, 30 steers from the different lines of breeding have been placed in the feed lot. Data gathered from the performance of the steers will be used in evaluating the different lines.

No Angus cattle have been purchased as yet, so the crossing program between Angus and Brahman cattle has not been initiated.

The performance of the Brahman-Angus, Africander-Angus, and Brahman cattle is presented in the accompanying table.

(c) Management: The experimental program as outlined requires a considerable increase in herd size at the Jeanerette Station. Pasture renovation work is being conducted on 275 acres at the present time. This work includes plowing, ditching, crowning and seeding. The carrying capacity of the station is being rapidly increased.

POSTWEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING

Louisiana Station
Jeanerette

Line or group designation Breeding of calves	ROP Bulls Purebred Brahman	ROP Bulls Africander - Angus	ROP Bulls Brahman - Angus
Bulls, No.	4	1	13
Av. inbreeding (%)	0	6.25	3.22
Av. weaning wt.	471	535	541
Length of feeding period	140	140	140
Feed per cwt. gain (lbs.)			
Concentrates	417	557	454
Roughage	343	545	371
Av. daily gain on test	1.89	1.64	2.14

PERFORMANCE OF COW HERDS. 1953 CALVES
(Calves grouped by breed of dam)

Louisiana Station
Baton Rouge

Breed of dam*	Angus	Brahman	Brangus	Hereford
No. cows bred	48	48	48	48
No. cows calving	29	30	37	33
No. calves raised	27	26	34	31
Av. birth wt. (lbs.)	65	56	67	70
Av. birth date	2-26-53	3-20-53	3-3-53	3-3-53
Were calves creep fed?	No	No	No	No
Av. wt. 6 mo. (lbs.)	380	370	397	369
Av. weaning date	10-29-53	10-29-53	10-29-53	10-29-53
Av. weaning weight	444	414	466	417
Av. wean. type score**	14.3	13.3	13.8	13.9

* 8 cows of each breed bred to bulls of each of the following breeding: Angus, Brahman, Drangus, Charolaise, Hereford, and Shorthorn.

** 9-11 = Good; 12-14 = Choice; 14-16 = Fancy.

PERFORMANCE OF COW HERDS. 1953 CALVES
(Calves grouped by breed of sire)

Louisiana Station
Baton Rouge

Breed of sire*	Angus	Heref.	S'horn	Brah.	Br-Ang.	Char.
No. cows bred	32	32	32	32	32	32
No. cows calving	27	23	11	14	26	28
No. calves raised	25	19	11	13	24	26
Av. birth wt.(lbs)	58	69	62	62	64	71
Av. birth date	3-1-53	2-28-53	2-28-53	3-9-53	3-3-53	3-14-53
Were calves creep fed?	No	No	No	No	No	No
Av. wt. 6 mo. (lbs.)	351	407	373	356	361	420
Av. weaning date	10-29-53	10-29-53	10-29-53	10-29-53	10-29-53	10-29-53
Av. weaning wt.	402	473	430	417	419	487
Av. wean. type score	14	15	14	15	13	13

* The bull of each breed bred to eight cows of each of the Hereford, Angus, Brahman, and Brahman-Angus groups.

PERFORMANCE OF COW HERDS. 1953 CALVES

Louisiana Station
Jeanerette

Breed of sire	Purebred Brahman	Africander-Angus	Brahman-Angus
Breed of dam	"	"	"
No. cows bred	16	35	94
No. cows calving	9	29	70
No. calves raised	8	28	64
Av. inbr. of dams (%)	0	1.83	3.13
Av. inbr. of calves (%)	0	11.60	5.47
Av. bir. wt. (lbs.)	55	66	62
Av. birth date	2-17-53	2-8-53	2-12-53
Were calves creep fed?	No	No	No
Av. wt. 6 mo. (lbs.)	337	382	405
Av. weaning date	10-5-53	10-5-53	10-5-53
Av. weaning weight	416	459	484
Av. wean. type score*	77	76	79

* On scale with 100 as top score.

MARYLAND STATION

Submitted by J. E. Foster and W. W. Green, December 20, 1953

1. Project Title: C-14 A Study of Productiveness of Purebred Beef Cattle in Maryland.

2. Objectives:

(a) To study productiveness of existing or introduced stocks of beef cattle. Productive characteristics measured will include rate of gain, economy of gain, market type, carcass quality, fertility, longevity, adaptation to environmental conditions, and other factors affecting the utility value of beef cattle.

(b) To compare selective criteria (individual and pedigree) with actual performance of progeny.

(c) To evaluate breeding technics for small purebred herds under the varying conditions encountered in practice in purebred herds.

(d) To attempt to produce beef cattle with superior productive capacities by line breeding and selection. (Using criteria of selection as developed in this project and by cooperating stations in this and other regions.)

3. Accomplishments during year:

Cooperation is being maintained with the owner of the Aberdeen-Angus herd mentioned last year and the same records are being secured. Weights and measurements have been systematically secured from the Aberdeen Angus and Hereford herds belonging to the University.

A study was made of various ways of estimating the 180 day weights of calves. Data collected under this project and project C-14-a were used. Three methods of calculation were checked for accuracy of prediction in the first phase of the study: (1) birth weight and 146 day weight, (2) birth and 202 day weights, and (3) 146 and 202 day weights. These weights were gotten from C-14-a. All three methods gave satisfactory results when estimated weights were checked against actual 180 day weights. The standard deviations of differences between actual and estimated 180 day weights for the three methods were: (1) 9.2 lbs., (2) 8.6 lbs., and (3) 6.4 lbs. (N. = 79 calves).

One part of the second phase of the study was to use average birth weights instead of actual birth weights for estimating 180 day weights using methods 1 and 2 on the calves used in the first phase. The results were essentially the same where average birth weights were substituted for actual birth weights. A second part of the second phase was to use data based on 82 calves where estimated weights had been calculated based on actual birth weights

Maryland Station (continued)

and a second weight taken within 30 days of the 180 day age and comparing these estimates with those based on an average birth weight figure. The estimated 180 day weights based on an average birth weight were the same as when the actual birth weight was used in 56 cases; there was a one pound difference in 23 cases and a two pound difference in three cases.

4. Future Plans:

Cooperation will be continued with the owner of the Aberdeen Angus herd on the present basis and records will be secured on the University herds.

5. Publications:

None.

6. Publications Planned:

Perhaps one on the use of average rather than actual birth weights.

1. Sub-Project C-14-a: Effects of Early Weaning on the Duration of Maternal Influences in Beef Calves.

2. Objectives:

(a) To attempt to develop a new technic for an earlier evaluation of feedlot performance, progeny testing, and genetic evaluation of beef animals.

(b) To develop sound feeding and management practices for beef calves weaned at an early age.

(c) To evaluate the calves' genetic ability to thrive under new systems of care.

3. Accomplishments during year:

The 22 calves representing progeny groups of two sires which were on feed last year completed their trials. Thirty-two calves (3 sire groups) were placed on feed last summer on the same basis as those fed last year. Individual feed and weight records are being kept. Work has been initiated on summarizing these data.

Work has been initiated on preliminary determinations of the heritability of rate and economy of gain for the calves weaned at 90 and 180 days of age. Prior to actual heritability studies, an attempt to partition the feed intake into that used for growth and that used for maintenance was made by use of methods published by Winchester and Hendricks (U.S.D.A. Tech. Bul. 1071). Data of 86 calves were used. Calculations were made on the basis of both T.D.N. and net energy. Compared to other standards, the estimated maintenance values based on either T.D.N. or net energy seemed too high

and feed required for gain appeared to be too low. These results were not too surprising as the data did not include animals which were being kept at or near maintenance levels. Heritability studies were deferred for the above study because of the possibility of perhaps determining the heritability factors for maintenance and growth separately rather than on the basis of gross T.D.N. or net energy.

A series of 46 linear measurements are being taken now on all calves when they go on feed (at 90 or 180 days), 180 days, and 370 days of age. These data will later be used to study relationships of measurements with characteristics of rate and economy of gain and of others of economic importance.

4. Future Plans:

The feeding trials now underway will be completed. Additional sire groups will be put on feed in the summer of 1954 if at all possible. The above mentioned measurements will be taken. Heritability studies and summarizations of the data will proceed as rapidly as possible.

5. Publications:

Buric, J., W. W. Green, and J. E. Foster. Early Weaning of Beef Calves for Earlier Evaluation of Rate and Economy of Gain. Jour. An. Sci. 11: 737-738, 1952. (Abs.)

Green, W. W., and John Buric. Comparative Performance of Beef Calves Weaned at 90 and 180 Days of Age. Jour. An. Sci. 12: 561-572, 1953.

6. Publications Planned:

The study of the partitioning of feed intake into that used for maintenance and that used for growth, plus some heritability studies will probably be published in the form of a Master's Thesis.

1. Sub-Project C-14-b: Type Classification as an Aid in Selection of Beef Breeding Cattle.

2. Objective: To determine the value of type classification in beef cattle, i.e., heritability of beef type and production.

3. Accomplishments during year: One cooperator's herd and the Aberdeen Angus and Hereford herds of the University have been classified twice during the past year. No analysis of accumulated data has been done.

4. Future Plans: Classification will be continued on a semi-annual basis on the herds now under study. As a project of this type requires the accumulation of data over a period of time, no analysis of the data is contemplated during next year.

5. Publications during year and publications planned: None.

POSTWEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING

Maryland Station

Line or group designation	Univ.of Md.	Univ.of Md.	Univ. of Md.
Breeding of calves	Aberdeen-Ang.	Aberdeen-Ang.	Hereford
	Individually Fed	Group Fed	Group Fed
Steers, No.	6	3	5
Av. inbreeding (%)	Outbred herd	Outbred herd	Outbred herd
Av. weaning wt.	358 1/	445 (221 days)	398 (207 days)
Av. 12 mo. wt.	670	775	696
Length of feeding period	190 2/	167	167
Feed per cwt. gain (lbs)	780 3/	774 (fed together)	
Concentrates	520	503	
Silage		86	
Roughage (hay)	260	185	
Av. daily gain on test	1.70	1.90	1.97
Av. type score (12 mo.)*	13	14	13
Heifers, No.	5	2	5
Av. inbreeding (%)	Outbred herd	Outbred herd	Outbred herd
Av. weaning wt.	313 4/	443 (223 days)	405 (232 days)
Av. 12 mo. wt.	583	745	642
Length of feeding period	190 5/	167	167
Feed per cwt. gain (lbs)	840 3/	788 (fed together)	
Concentrates	560	510	
Silage		82	
Roughage (hay)	280	196	
Av. daily gain on test	1.45	1.99	1.84
Av. type score (12 mo.)*	13	15	13

1/ At 180 days - includes the 180 day weight of one steer weaned at 90 days of age.
2/ One steer weaned at 90 days was fed for 280 days.
3/ Feed was fed mixed - 2 parts concentrate, 1 part hay.
4/ At 180 days - includes the 180 day weight of 4 heifers weaned at 90 days of age.
5/ 4 heifers weaned at 90 days were fed for 280 days.

* 9-11 = Good; 12-14 = Choice; 15-17 = Fancy.

PERFORMANCE OF COW HERDS. 1953 CALVES

Maryland Station

Line or group designation	Univ. of Md.	Univ. of Md.
Breed of sire	Aberdeen Angus	Hereford
Breed of dam	Aberdeen Angus	Hereford
No. cows bred	26	17
No. cows calving	23	16
No. calves raised	22	15
Av. inbr. of dams (%)	outbred herd	outbred herd
Av. inbr. of calves (%)	outbred herd	outbred herd
Av. birth wt. (lbs.)	59	69
Av. birth date	3/11/53	3/1/53
Were calves creep fed?	No	No
Av. wt. 6 mo. (lbs.)	355(1)	361
Av. weaning date	8/29* 10/8(*)	10/8
Av. weaning wt.	349* 432	434
Av. wean. type score **	14	13
Av. wean. cond. score**	13	12

(1) 6 were weaned at 90 days.
* For 6 calves weaned at 6 months; 6 were weaned at 90 days.
(*) For 9 calves.
** 9-11 = Good; 12-14 = Choice.

MISSISSIPPI STATION

Submitted by Charles E. Lindley, December 29, 1953

1. Project Title: A Study to Determine the Breeding Worth of Inbred and Outbred Bulls from Various Sources.

2. Objectives:

   (a) To compare the growth rate, carcass qualities and maternal abilities of the progenies of bulls selected from various sources as being potentially superior sires.

   (b) To develop a high producing herd of cows by using the progeny of good producing bulls as replacement heifers.

   (c) To determine the effectiveness of a selection index when used on heifers at weaning time.

3. Accomplishments during year:

   Development of facilities and improvement of pastures has continued on the 2000 acres of land on lease from the Air Force. The area has been fenced to permit breeding of bull units. Cutting pens and weighing facilities have been obtained in order to get data required to meet the objectives of this study.

   A total of 350 grade breeding females are available, including Hereford, Angus and Shorthorn. Commercial bulls of all three breeds plus 2 Hereford bulls of an inbred line have been obtained for the next breeding season. Negotiations are underway to obtain bulls from another Hereford line for the 1954 breeding season. Plans are being developed to use artificial insemination on a limited scale in order to test bulls of outstanding quality as well as bulls of lines which, at present, would not otherwise be obtainable.

   Since the study will begin with the breeding season of the spring of 1954, no research results are yet available.

4. Publications:

   None.

5. Publications Planned:

   None.

NORTH CAROLINA STATION

Submitted by H. A. Stewart, January 12, 1954

1. Project Title: State 74-Ai28 The Improvement of Beef Cattle Through Breeding Methods.

State 46-Ai17 The Development of Beef Cattle Especially Adapted to the Coastal Plains Region of North Carolina and Similar Areas.

2. Objectives:

(a) To compare groups of cattle from different topcrosses on grade Hereford cows and F_2 generations from them for their adaptability under Coastal Plains conditions.

(b) To establish breeding groups of cattle from topcrosses of Brahman and Africander breeding to grade Hereford and Angus cows.

(c) To establish a breeding group from the Romo-Sinuano-Hereford crossbred population.

(d) To evaluate the feedlot performance of purebred Hereford, Angus and Shorthorn bulls and heifers and prospective Brahman-Hereford F_2 and Africander-Hereford F_2 herd bulls.

(e) To continue the study of total performance of the progeny of bulls used in the same herd the same year.

3. Accomplishments during year:

Four homebred and 4 purchased Hereford and 3 homebred Angus bull calves were full fed together on pasture for a period of 168 days. Regular 28 day reports were made to the breeders of the purchased bulls. At the conclusion of the trial, one purchased bull was slaughtered and the 7 other Herefords and 1 Angus were each assigned to a cow herd. Breeding performance of all young bulls was satisfactory.

Eleven Hereford, 4 Angus and 1 Shorthorn heifers were limit fed together on pasture for the same period as the bull group. Those heifers weighing over 725 pounds were put into breeding groups at the conclusion of their feeding trial.

Two Romo-Sinuano-Hereford F_2 bull calves were dropped during the year. These are the first males produced since the original F_1 group. One of these calves was discarded because of a genital malformation. The other calf was put on the feeding trial with all other bull calves after weaning. The average 182 day weight of the Romo-Sinuano-Hereford calves continued to be above the average of the other breeds but their body score is the lowest of any of the breeding groups except those at the Frying Pan Range.

North Carolina Station (continued)

No calves were dropped to the service of the Brahman-Hereford F_2 bull in 1953. The calves produced by the cows of this group were by bulls of other breeding. This accounts for the late calving in this group.

The Brahman-Hereford F_1 and the Africander-Hereford groups weaned heavier calves than the grade Hereford group. The six month weights of the Africander group averaged 372 pounds, about 38 pounds more than the Brahman-Hereford F_1's. Differences between these groups have not been in this order in previous years.

4. Future Plans:

Feedlot testing is being continued on all bull calves at Raleigh including prospective herd sires from the various crossbred groups.

Sample steer progenies from the tested bulls used on grade herds will continue to be fed for slaughter grade and carcass evaluation. Heifer gains on pastures will be compared to the feedlot gains of their steer mates.

Inter se matings will be continued within each of the three groups: Brahman-Hereford; Africander-Hereford-Angus; and, Romo-Sinuano-Hereford. Selections within these groups will be based on reproductive performance, rate of gain and carcass quality.

5. Publications:

Beef Cattle Breeding Research in North Carolina, N. C. Expt. Sta. Quarterly, Research and Farming. In Press.

POSTWEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING

North Carolina Station

Line or group designation	Angus	Hereford	Shorthorn	R-S x H
Location	Raleigh	Raleigh	Raleigh	Raleigh
Breeding of calves	Angus	Hereford	Shorthorn	R-S x H
Bulls, No.	3	8		
Av. init. age (days)	187	255		
Av. init. wt. (lbs.)	520	561		
Length of feeding period	168	168		
Feed per cwt. gain (lbs)				
Concentrates	655/Fed together on pasture. Figures on			
Roughage	181\feed efficiency are for both breeds.			
Av. daily gain on test	2.16	2.33		
Av. type score (12 mo.)*	9	11		
Heifers, No.	4	12	2	3
Av. weaning wt.	492	515	370	500
Av. 12 month wt.	660	649	707	696
Length of feeding period	168	168	168	168
Feed per cwt. gain (lbs)				
Concentrates	591/Fed together on pasture. Figures on			
Roughage	360\feed efficiency are for all groups.			
Av. daily gain on test	1.72	1.47	1.75	1.56
Av. type score (12 mo.)*	13.5	13.4	11.0	9.0

* 9-11 = Good; 12-14 = Choice.

PRODUCTION AND SLAUGHTER DATA ON YEARLING CATTLE
NOT INCLUDED IN BREEDING HERDS IN 1953

North Carolina Station

Location	Upper Mountain Exp. Sta.			Tidewater Exp. Sta.	
Sire	Heref. bull 77	Heref. bull 83	Heref. bull 65	Bull 80	Bull 82
Breeding:	Gr.Heref.	Gr.Heref.	Gr.Heref.	Gr.Heref.	Gr.Heref.
Sex	Steer	Steer	Steer	Steer	Steer
No.	7	4	5	8	8
Av. age (fall 1952)	216 days	232 days	231 days	251 days	236 days
Av. wt. (fall 1952)	440	424	374	399	366
Av. winter gain	136	131	133	81	111
Days on pasture	179	179	179	169	169
Av. gain on pasture	269	264	276	201	231
Days on feed	Finished on pasture			?	?
Av. wt. adjusted to 18 months of age	788	738	700	721	692
Av. gain on feed				192	145
Animals slaughtered:	7	4	5	2	2
Av. age at slaughter	19 mo.	20 mo.	20 mo.	21 mo.	20 mo.
Av. slaughter wt.	846	819	783	790	755
Av. slaughter grade*	10	9	9	9	8
Av. dressing percent	51.6	52.7	53.2	58.7	56.6
Av. carcass grade*	9.4	9.2	9.2	9	8

* 6-8 = Commercial ; 9-11 = Good.

PERFORMANCE OF COW HERDS. 1953 CALVES

North Carolina Station

Line or group	Hereford	Hereford	Hereford	Hereford	Hereford
Location	Tidewater Exp. Sta.		Upper Mountain Exp. Sta.		
Breed of sire	Hereford (102)	Hereford (104)	Hereford (77)	Hereford (114)	Hereford (105)
Breed of dam	Gr. Hereford	Gr. Hereford	Gr. Hereford	Gr.Hereford	Gr. Hereford
No. cows bred	25	24	10	16	12
No. cows calving	23	18	9	14	12
No. calves raised	22	18	9	12	11
Av. birth wt. (lbs.)	67	65	67	62	70
Av. birth date	2-19-53	2-16-53	1-13-53	1-23-53	1-18-53
Were calves creep fed?	No	No	No	No	No
Av. wt. 6 mo. (lbs.)	348	343	373	325	361
Av. weaning date	10-21-53	10-21-53	236 days	232 days	231 days
Av. weaning wt.	422	428	457	400	456
Av. wean. type score*	10 (6 mo.)	11 (6 mo.)	13.3	12.0	12.8

* 9-11 = Good; 12-14 = Choice.

PERFORMANCE OF COW HERDS. 1953 CALVES

North Carolina Station

Line or group	Pb. Hereford	Angus	Shorthorn	Gr.Hereford	Gr.Hereford	Romo-Sinuano x
Location	Raleigh	Raleigh	Raleigh	Raleigh	Raleigh	Raleigh
Breed of sire	Hereford	Angus	Shorthorn	Angus	Hereford	Romo-Sinuano x
Breed of dam	Hereford	Angus	Shorthorn	Gr.Hereford	Gr.Hereford	Romo-Sinuano x
No. cows bred	31	10	5	9	12	4
No. cows calving	26	10	2	9	10	4
No. calves raised	25	7	2	8	10	4
Av. birth wt. (lbs.)	64	61	58	63	70	68
Av. birth date	1-19-53	1-9-53	3-9-53	2-5-53	1-7-53	1-7-53
Were calves creep fed?	Yes	Yes	Yes	No	No	No
Av. wt. 6 mo. (lbs.)	387	407	352	323	422	434
Av. weaning date	9-15-53	9-11-53	9-24-53	9-24-53	9-24-53	9-12-53
Av. weaning weight	473	510	378	354	499	551
Av. 6 mo. type score*	10.7	10.3	11	8.6	11.4	7.5

* 6-8 = Medium; 9-11 = Good; 12-14 = Choice.

PERFORMANCE OF COW HERDS. 1953 CALVES

North Carolina Station

Line or group	Gr.Hereford	Br. x GHF_1	Br. x GHF_2	Africander x
Location	Fr. Pan Range	Fr. Pan Range	Fr. Pan Range	Fr. Pan Range
Breed of sire	Hereford	Brahman	Br. x GHF_2	Africander x
Breed of dam	Gr.Hereford	Gr. Hereford	Br.x GHF_1&F_2	Africander x
No. cows bred	21	21	26	13
No. cows calving	16	6	6	6
No. calves raised	15	6	6	6
Av. birth wt. (lbs.)	64	63	50	64
Av. birth date	3-7-53	3-8-53	4-26-53	3-15-53
Were calves creep fed?	Yes	Yes	Yes	Yes
Av. wt. 6 mo. (lbs.)	294	334	283	372
Av. 6 mo. type score	8.3	6.7	7.3	7.5
Av. weaning date	9-28-53	9-21-53	10-20-53	10-1-53
Av. weaning wt.	322	347	286	386

SOUTH CAROLINA STATION

Submitted by E. G. Godbey, December 15, 1953

1. Project Title: The Use of Brahman and Certain British Breeds of Beef Cattle in the Production of Fat Calves.

2. Objectives:

The objectives of this test were to determine the birth and weaning weights, market grades, carcass grades and dressing percentages of fat calves sired by Brahman, Hereford and Angus bulls. The calves at the Coast Station were out of purebred Angus cows and those at the College were out of purebred Hereford cows.

3. Accomplishments during year:

(a) Facilities and cattle acquired: The cow herds have been the same as those used in previous years. A few heifers have been added to the test. One Angus bull was purchased for the work at the College.

(b) Research results: Results secured in these tests are shown in the accompanying table. The birth weights of the three groups of calves were not significantly different. The weaning weights of the crossbred groups were higher than for the purebreds, but the difference was not as great as we have secured in some previous work. These results continue to show that the calves produced by crossing the English breeds are as heavy at weaning as those produced by Brahman-English crosses. The animal and carcass grades were not different in the three groups.

4. Future Plans:

The beef cattle breeding work will be continued at the Coast Station where a Shorthorn bull will be used on purebred Angus, Brahman-Angus, Hereford-Angus and Brahman-Hereford heifers. Weaning and birth weights will be obtained on the calves produced by these cattle.

5. Publications:

Results have been published in the South Carolina Experiment Station Report.

PERFORMANCE OF COW HERDS. 1953 CALVES

South Carolina Station
Clemson

Line or group designation	Hereford	Angus x Heref.	Brah. x Heref.
Breed of sire	Hereford	Angus	Brahman
Breed of dam	Hereford	Hereford	Hereford
No. cows bred	9	10	13
No. cows calving	9	10	10
No. calves raised	8	9	12
Av. birth wt. (lbs.)	69	63	69
Av. birth date	Feb. 3	Jan. 26	Feb. 3
Were calves creep fed?	Yes	Yes	Yes
Av. weaning date	Sept. 1	Aug. 24	Sept. 1
Av. weaning wt. (7 mo.)	439	467	459
Calves slaughtered at weaning:			
Steer or bull calves			
No.	5	1	4
Av. age	226 days	232 days	221 days
Av. weight	458	475	464
Av. slaughter grade	17 (L. Good)	18 (L. Good)	19 (L. Good)
Av. dressing percent	53.0	52.4	52.8
Av. carcass grade	18 (L. Good)	16 (M. Good)	18 (L. Good)

TENNESSEE STATION

Submitted by C. S. Hobbs and H. J. Smith, January, 1954.

1. Project Title: The Improvement of the Producing Ability of Beef Cattle.

2. Objectives:

(a) To develop lines or line crosses or combination of lines and crosses of beef cattle that will make the most efficient use of Tennessee pastures and forages and that will result in an improvement of such characters as rate of gain, economy of gain, carcass quality, fertility and longevity.

(b) To investigate the productiveness of existing lines of beef cattle.

(c) To develop effective breeding techniques for improving the productiveness of existing lines of beef cattle.

(d) To study the effect of different levels of nutrition on the development of type, conformation, economy of gain, fertility and longevity.

3. Accomplishments during year:

(a) Facilities and cattle acquired: Beef cattle breeding research under S-10 at the Tennessee stations includes herds at Knoxville, Alcoa, Oak Ridge, Greeneville, Crossville, Columbia, and Springfield. The expansion of cow herds to be used in the development of lines was continued at all stations with the addition of replacements from respective or other herds. Cow herds at some stations are now up to required numbers and the breeding programs aimed at developing lines will be initiated at these stations during 1954.

(b) 1. Sire testing studies: During the fall and winter of 1952-53 the Tennessee Station individually fed 30 bulls (25 Hereford and 5 Angus) under test conditions for 150 days on a groundmixed ration. Nineteen of these bulls were saved for progeny tests. The performance of these bulls is shown in the accompanying table. The performance of 4 steers by each of 3 Angus bulls is also shown. These steers were allotted uniformly across pasture experiments.

2. Level of feeding studies: The study on the effect of level of nutrition on the development of type, conformation, economy of gain, fertility and longevity was continued during 1953. Details of the procedures being used in the conduct of this experiment were given in the 1951 S-10 Annual Report. Briefly, trios of heifer calves are being fed on three different nutritional regimes: (1) nurse cow plus a full feed of concentrates and hay, (2) full feed of concentrates and hay and (3) customary practices for good commercial production. Growth and developmental phases to 18 months of age were completed on 3 trio groups. Several trio groups dropped their second calf crop during 1953.

3. Analysis of cow performance records at the Oak Ridge, Greeneville and Crossville stations were completed and estimates of repeatability obtained for birth weight, weaning weight, type score and condition score. The repeatability estimates from two sources for these characteristics are given in Table 1.

TABLE I. REPEATABILITY OF COW PERFORMANCE

Item	GREENEVILLE		CROSSVILLE		OAK RIDGE	
	Intraclass Correlation	Correlation of Adj.Calves	Intraclass Correlation	Correlation of Adj.Calves	Intraclass Correlation	Correlation of Adj.Calves
Bir. wt.	.01	-.01	.03	-.01	.30	.25
Wean. wt.	.61	.62	.21	.25	.43	.59
Wean.type score	.39	.28	.11	.16	.04	.09
Wean.cond. score	.51	.45	.04	.19	.07	.28

4. The photographic chute was used routinely to obtain photographic records and measurement data on all purebred animals in the breeding projects at all stations.

5. Performance of the cow herds at the various stations for 1953 is shown in the accompanying tables. Type and condition scores are reported as recommended by the Committee on Methods of Measurement.

4. Future Plans:

(a) Continue the program of performance testing young bulls from herds in the project.

(b) Continue the progeny testing of sires to be used in the breeding program.

(c) Continue the expansion of herds at Crossville, Columbia and Springfield not up to required numbers.

(d) Initiate breeding programs for the development of lines at stations with herds up to sufficient numbers.

(e) Continue the level of feeding studies.

(f) Continue the study on objective methods of obtaining linear measurements of beef cattle.

(g) Initiate line evaluation.

Tennessee Station (continued)

5. Publications:

Smith, H. J., E. J. Warwick, J. R. Paysinger, J. T. Guill and C. S. Hobbs. Repeatability of Cow Performance. Assn. South. Agric. Workers, Dallas, Texas, 1954.

Guill, James T. The Repeatability of Cow Performance in Beef Cattle. M. S. Thesis, Univ. of Tenn. Library, Knoxville, Tenn., 1953.

Paysinger, John R. The Repeatability of Cow Performance in Beef Cattle. M. S. Thesis, Univ. of Tenn. Library, Knoxville, Tenn., 1953.

6. Publications Planned:

Station bulletin on productivity factors in beef cattle. Results of work will be published as progress justifies.

POSTWEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING
(or pastured for high gains)

Tennessee Station

Line or group designation	Sire Testing		
Breeding of calves	PB Heref. and Angus		
Bulls, No.**	30 (25 Heref. 5 Angus)		
Av. initial wt.	421 (285-687)		
Av. final wt.	752 (553-1073)		
Length of feeding period	150		
Feed per cwt. gain (lbs)			
Concentrates	317.5		
Roughage	317.5		
Av. daily gain on test (lbs)	2.21(1.52-2.68)		
Av. type score (12 mo.)	12.3		
Steers, No.***	4	4	4
Steers sired by:	U.T. Eppy (Angus)	U.T. Blackbird (Angus)	U.T. Gr.Oaks 2" (Angus)
Av. initial wt.	477	466	423
Av. final wt.	927	932	869
Length of feeding period*	339	339	339
Feed per cwt. gain (lbs)			
Concentrates			
Roughage			
Av. daily gain on test	1.33	1.37	1.32
Av. sl. grade (18 mo.)	12	12	12.2

* Includes wintering phase (152 days), summer grazing phase (131 days) and fattening period (56 days). Steers were allotted uniformly across pasture experiments.

** Bulls raised at various locations in state, fed out at Oak Ridge.

*** Raised at Crossville, fed out at Greeneville.

PERFORMANCE OF COW HERDS. 1953 CALVES

	Tennessee Station								
	Crossville					Greeneville			
Line or group	Sire Testing					Sire Testing			
Breed of sire	Ang.(Gen. of Mac.355)	Ang. (UT Bl'oak 2)	Ang. (UT Gr.Oaks)	Shorthorn	Hereford	Here.(Noes Baca D.117)	Here. (WHR Wor. Duke)	Here. (Sir Dou.Roy.114	Here.(Sir Dou.Roy.120)
Breed of dam	Angus (PB & Gr.)	Angus (PB & Gr.)	Angus (PB & Gr.)	Gr.Heref. x S'horn	Gr.Heref. x S'horn	Heref.	Heref.	Heref.	Heref.
No. cows bred	28	10	14	18	19	12	24	7	9
No. cows calving	20	10	5	13	16	12	21	7	9
No. calves raised	20	10	5	13	16	12	16	7	9
Av. birth wt.(lbs)	58	58	64	76	73	73	71	69	72
Av. birth date (1953)	4-14	3-9	5-31	5-15	5-5	2-18	3-19	3-4	2-21
Were calves creep fed?	No	No	No	No	No	No	No	No	No
Av. wt. 6 mo. (lbs.)	391	380	418	418	433	356	346	349	361
Av. weaning date ('53)	11-4	11-4	11-4	11-4	11-4	11-3	11-3	11-3	11-3
Av. weaning wt.	412	467	357	398	443	438	412	411	439
Av. wean.type score*	13.2	12.4	12.1	12.2	12.2	11.5	11.7	10.6	11.1
Av. wean.cond.score*	12.7	12.1	12.2	11.0	12.3	9.5	9.6	8.9	9.2

* Good = 9-11; Choice = 12-14; Fancy or Prime = 15-17.

PERFORMANCE OF COW HERDS. 1953 CALVES

Tennessee Station

	Alcoa				Columbia			Springfield
Line or group	Sire Testing				Sire Testing			Sire Testing
Breed of sire	Here. (OW Larry Dom.4)	Here. (S.H. Roy.Duke 5)	Here.(UT Helmsman 1)	Here. (Noes Larry D. 236)	Here. (Sir Dou.Roy.114)	Here.(Sir Dou.Roy.120)	Here.(Sir Proud Pr.22)	Here. (Noes Baca Duke 31)
Breed of dam	Heref.	Heref.	Heref.	Heref.	Heref.	Heref.	Heref.	Heref.
No. cows bred	15	5	4	19	17	21	2	20
No. cows calving	15	5	4	19	17	20	2	15
No. calves raised	14	5	4	19	16	20	2	14
Av. bir. wt. (lbs)	70	57	60	69	61	61	58	81
Av. bir. date (1953)	4-27	3-4	3-1	3-18	2-24	2-16	2-20	
Were calves creep fed?	No	No	No	No	No	No	No	No
Av. wt. 6 mo. (lbs.)	371	350	371	374	276	259	329	398
Av. wean. date (1953)	10-27	10-27	10-27	10-27	10-15	10-15	10-15	11-11
Av. wean. weight	366	414	434	428	340	316	318	432
Av. wean. type score*	11.6	12.2	10.9	11.4	10.4	9.7	10.2	11.2
Av. wean. cond. score*	10.7	11.8	10.5	11.0	7.2	6.6	6.5	10.7

* Good = 9-11; Choice = 12-14; Fancy or Prime = 15-17.

PERFORMANCE OF COW HERDS

Tennessee Station
Oak Ridge

	Fall - 1952			Spring - 1953			
Bull	-3	246	238	-13	-14	-38	-40
Breed of bull	P.Heref.	P.Heref.	P.Heref.	Heref.	Heref.	Heref.	Heref.
Breed of cows	Heref.	Heref.	Heref.	Heref.	Heref.	Heref.	Heref.
No. cows bred	24	7	4	11	14	16	11
No. cows calving	24 1/	7 2/	4				
No. calves raised	22	5	4	10 3/	14	16	8 4/
Av. bir. wt. (lbs)	75	63	80	76	75	76	71
Av. birth date	9-6-52	8-21-52	8-19-52	2-20-53	2-28-53	3-6-53	2-22-53
Were calves creep fed?	No	No	No	No	No	No	No
Av. wt. 182 days (lbs)	244	287	358	398	389	367	380
Weaning date	5-8-53	5-8-53	5-8-53	9-15-53	9-15-53	9-15-53	9-15-53
Av. wean. wt.	479	449	539	496	461	420	456
Av. wean. type score	HG+	G+	HG	G	HG+	LCh-	HG
Av. wean. cond. score	LG	LG	LG	G+	HG	HG	HG

1/ One cow had twins born dead, another calf died first day.
2/ One cow had stillbirth, one other calf died.
3/ One stillbirth.
4/ 2 cows failed to settle - one calf died in June.

PERFORMANCE OF COW HERDS

Tennessee Station
Oak Ridge

Spring 1953

Bull	-58	Noes Baca Duke 117	246	346	369	WHR Worthy Duke	Advance A. Dom.
Breed of bull	Hereford	Hereford	P.Heref.	P.Heref.	P.Heref.	Hereford	Hereford
Breed of cows	Hereford	Hereford	Hereford	Hereford	Hereford	Hereford	Hereford
No. of cows bred	14	?	5	18	10	?	?
No. calves raised	12[1]/	14[2]/	5	15[3]/	5[4]/	11[5]/	16[6]/
Av. bir. wt. (lbs)	78	72	84	71	76	74	67
Av. birth date	2-25-53	2-18-53	1-26-53	2-15-53	3-6-53	2-27-53	4-14-53
Were calves creep fed?	No	No	No	No	No	No	No
Av. wt. 182 days	413	416	445	396	379	420	367
Weaning date	10-15-53	10-15-53	10-15-53	10-15-53	10-15-53	10-15-53	10-15-53
Av. wean. wt.	493	501	566	479	448	485	371
Av. wean. type score	HG	LCh+	G+	G	HG+	LCh+	HG
Av. wean. cond. score	HG+	LCh	HG+	HG	LCh-	LCh-	HG-

1/ 1 cow failed to settle - one stillbirth.
2/ Cows bred at Greeneville - one had stillbirth.
3/ 2 cows failed to settle - one stillbirth.
4/ This bull was only a yearling and cows failing to settle were large.
5/ Bred at Greeneville.
6/ Bred at Columbia.

TEXAS STATION

Submitted by Bruce L. Warwick, T. C. Cartwright, H. O. Kunkel,
J. J. Bayles and L. A. Maddox, January 5, 1954

1. Project Title: This work is supported by three Texas State Projects. The first of these, R-M 607 "Improvement of Beef Cattle through Selection of Performance-Tested and Progeny-Tested Sires" is in progress at Balmorhea, McGregor, and Panhandle, Texas.

2. Objectives:

   (a) To determine the heritability of gain and other economic characteristics as beef conformation, quality of fleshing, earliness of maturity and size of animal.

   (b) To study the effects of the application of such information on the improvement of breeding herds.

   (c) To determine the mode of inheritance of the pigmentation of the eyelids and to determine the relationship of eyelid pigmentation to "cancer eye".

   (d) To make a more detailed analysis of the existing data resulting from the previous work that has been carried out under Texas Experiment Station Project 550.

   (e) To determine suitable and economical rations of locally grown feeds and supplements for proper development of young breeding stock in conjunction with Texas Station Project 550.

3. Accomplishments during year:

   Evaluation of calves for gaining ability on growing rations in the feed lot was conducted at Balmorhea, Panhandle and McGregor, Texas. Of the 633 head tested at these three points, 411 were owned by cooperators. Of the others, 202 were raised by the Texas Station at Bluebonnet Farm on experiment R-M 650 listed below, and the results were used directly for selection of individuals and of sires. The remaining 20 were raised at Pan Tech Farms. There was great variability between sire groups and between individuals. Calves sired by bulls whose own gain test records were either high or low were included in the tests at Pan Tech Farms and at Bluebonnet Farm. At each location the progeny of the high gaining bull averaged higher in gain than the progeny of the low gaining bull. At Bluebonnet Farm, progeny of a medium gain sire were also included, but the gain of the progeny of the medium and low gaining sires were about the same. Additional high gaining sires have been secured on loan by the Station and their progenies will be tested in the future. The results of the tests are being used for selection purposes by private breeders as well as in the Station herds.

POSTWEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING

Calves owned by cooperators. Texas Station Balmorhea

Line or group designation	Heref.	Heref.	F_1 Heref. x Brah.	Brah.
Bulls, No.	68			5
Av. wt. 11/18/52	591			442
Av. 12 mo. wt. 4-7-53	933			730
Length of feeding period*	140			140
Feed per cwt. gain (lbs.)	913			792
Concentrates	265			243
Roughage	648			549
Av. daily gain on test	2.44			2.06
Av. type score**	12.0			--
Steers, No.	18	7	12	
Av. weaning wt. 12/2/52	502	351	438	
Av. 12 mo. wt. 4/7/52	738	600	666	
Length of feeding period*	126	126	126	
Feed per cwt. gain (lbs.)	959		953	
Concentrates	290		290	
Roughage	669		663	
Av. daily gain on test	1.88	1.98	1.81	
Av. type score (12 mo.)**	--	--	--	
Heifers, No.	46			4
Av. wt. 11/18/52	504			372
Av. wt. 4/7/53	754			589
Length of feeding period *	140			140
Feed per cwt. gain (lbs.)	1105			906
Concentrates	326			290
Roughage	779			616
Av. daily gain on test	1.79			1.55
Av. type score (12 mo.)**	12.3			--

* Self-fed a mixed ration with roughage and concentrates in proportions indicated.

** 2-6 = Prime or Fancy; 8-12 = Choice; 14-18 = Good.

POSTWEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING
1952-53 Test

Calves owned by Cooperators: 140 bulls, 11 heifers — Texas Station
Calves owned by Pan Tech Farms: 2 heifers — Pan Tech Farms

Breeding of calves	All Here. & Ang.	Hereford	Angus
Bulls			
Number	140	122	18
Av. init. wt. (11-13-52)	595	594	595
Av. final wt. (4-2-53)	930	933	925
Length of feeding period	140	140	140
Feed per cwt. gain (lbs)*	959	992	954
Concentrates	327	324	337
Roughage	632	630	655
Av. daily gain on test	2.39	2.40	2.29
Initial grade **	12.1	12.2	11.8
Final grade **	12.4	12.5	11.9
Highest daily gain	3.24	3.24	2.80
Lowest daily gain	1.69	1.69	1.73
Heifers			
Number	13	11	2
Av. init. wt. (11-13-53)	539	565	398
Av. final wt. (4-2-53)	808	834	668
Length of feeding period	140	140	140
Feed per cwt. gain (lbs)*	1110		
Concentrates	377		
Roughage	733		
Av. daily gain on test	1.92	1.92	1.93
Initial grade**	12.5	12.2	13.3
Final grade**	11.3	11.1	12.3
Highest daily gain	2.23	2.23	2.17
Lowest daily gain	1.56	1.56	1.69

* Self-fed a ground mixed ration composed of:

Cottonseed hulls	31%
Alfalfa	20%
Milo fodder	15%
Milo grain	19%
Cottonseed meal	15%

** 8-12 = Choice; 12.1-16 = Good; 16.1 and over = Medium.

PERFORMANCE OF 1952 CALVES SIRED BY HIGH & LOW GAINING BULLS
OUT OF RANDOM SELECTED COWS

Calves Owned by Pan Tech Farms — Texas Station Pan Tech Farms

Line or group designation	All Steers	Sired by High Gaining Bulls	Sired by Low Gaining Bulls
Breeding of calves	Hereford	Hereford	Hereford
Steers			
Number	8	4	4
Av. init. wt. (11-13-52)	501	530	472
Av. final wt. (4-2-53)	771	822	720
Length of feeding period	140	140	140
Feed per cwt. gain (lbs)*	1108		
Concentrates	377		
Roughage	731		
Av. daily gain	1.93	2.09	1.77
Initial grade**	12.7	12.5	13.0
Final grade**	12.7	13.1	12.1
Dressing %	59.9	60.7	59.1
Highest daily gain	2.16	2.16	1.98
Lowest daily gain	1.51	1.94	1.51
Heifers[1/]			
Number	10	5	5
Av. wean. wt. (10-17-52)	436	455	417
Av. wt. (9-17-53)	686	724	648

1/ Calves wintered on C/S/M and Native Grass. Summered on Native Grass alone.

*
** > See previous table for these footnotes.

PERFORMANCE OF COW HERD
1953 Calves

CALVES SIRED BY HIGH AND LOW GAINING BULLS
OUT OF RANDOM SELECTED COWS

Calves Owned by Pan Tech Farms		Texas Station Pan Tech Farms
Record and Breed of Sires	Two High Gaining Hereford Bulls	Two Low Gaining Hereford Bulls
Record and Breed of Cows	Random Selected Hereford Cows	Random Selected Hereford Cows
No. cows bred	36	36
No. of cows calved between Feb. 5 and Apr. 18, 1953	27	28
No. of calves weaned	25	26
Were calves creep fed?	No	No
Av. weight - Oct. 19, 1953	492	442
Av. age (approx.)	7 mo.	7 mo.

FOLLOWING NOTES REFER TO TEST AT BLUEBONNET FARM: (Data in two following tables)

(1) All calves except two lots mentioned below were fed a low concentrate ration as follows: (growing ration)

Milo grain	20
Cottonseed meal	15
Hegari hay	35
Johnson grass hay	28
Alfalfa leaf meal	2
	100

(2) The ration for these steers, fed high concentrate ration is as follows: (fattening ration)

Milo grain	55
Cottonseed meal	10
Alfalfa leaf meal	2
Johnson grass hay	28
Ear corn	5
	100

Stabilized vitamin A concentrate was added to supplement the supply in the alfalfa leaf meal.

POSTWEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING

Texas Station
Bluebonnet Farm

Line or group designation	Hereford	Brahman	Crossbred	Backcross
Breeding of calves	Hereford	Brahman	F_1 (H x B)	(F_1 HxB) x Hereford
Bulls, No.	6 26*	12 13*	9	
Av. wt. 12-8-52	540	517	559	
Av. wt. 4-27-53	849	760	870	
Length of feeding period[1/]	140	140	140	
Feed per cwt. gain (lbs)	904	1002	968	
Concentrates	316	351	339	
Roughage	588	651	629	
Av. daily gain on test	2.2	1.7	2.2	
Highest daily gain	3.1	2.5	2.7	
Lowest daily gain	1.5	.9	1.6	

	G. R.	F. R.		G. R.	F. R.	
Steers, No.	15 19*	8		23	20	
Av. wt. 12-8-52	424	470		489	492	
Av. wt. 4-27-53	697	762		692	726	
Length of feeding period[1/]	140	140[2/]		140	140[2/]	
Feed per cwt. gain (lbs.)	923	846		1250	1069	
Concentrates	323	592		438	748	
Roughage	600	254		812	321	
Av. daily gain on test	1.9	2.1		1.5	1.7	
Highest daily gain	2.5	2.6		2.2	2.2	
Lowest daily gain	1.6	1.8		.7	1.0	

Heifers, No.	34 15*	12 3*	57	4
Av. wt. 12-8-52	443	441	437	422
Av. wt. 4-27-53	677	626	651	636
Length of feeding period[1/]	154	154	154	154
Feed per cwt. gain (lbs.)	1042	1172	1114	1114
Concentrates	365	410	390	390
Roughage	677	762	724	724
Av. daily gain on test	1.7	1.3	1.5	1.6
Highest daily gain	2.2	1.8	2.3	1.6
Lowest daily gain	1.0	1.0	.8	1.4

* Asterick indicates cooperator owned cattle.

See previous sheet for rations fed.

POSTWEANING PERFORMANCE OF 1952 CALVES FULL FED AFTER WEANING

			Texas Station Bluebonnet Farm	
Line or group designation	Backcross	Charbray	Santa Gertrudis	
Breeding of calves	(F_1, HxB x Brah.)	Charbray	Santa Gertrudis	
Bulls, No.	2	3*		
Av. wt. 12-8-52	437	647		
Av. wt. 4-27-53	755	1001		
Length of feeding period	140	140		
Feed per cwt. gain (lbs.)	968	855		
Concentrates	339	299		
Roughage	629	556		
Av. daily gain on test	2.3	2.5		
Highest daily gain	2.7	2.9		
Lowest daily gain	1.8	2.3		
			Grow. R.1/	Fat. R.2/
Steers, No.			4*	4*
Av. wt. 12-8-52			445	478
Av. wt. 4-27-53			718	758
Length of feeding period			140	140
Feed per cwt. gain (lbs.)			974	906
Concentrates			341	634
Roughage			633	272
Av. daily gain on test			2.0	2.0
Highest daily gain			2.1	2.4
Lowest daily gain			1.7	1.5
Heifers, No.		3*	10*	
Av. wt. 12-8-52		725	527	
Av. wt. 4-27-53		960	751	
Length of feeding period		140	140	
Feed per cwt. gain (lbs.)		1196	1222	
Concentrates		419	428	
Roughage		777	794	
Av. daily gain on test		1.7	1.6	
Highest daily gain		1.9	1.8	
Lowest daily gain		1.4	1.3	

* Asterick indicates cooperator owned.

See second previous sheet for rations fed.

1. Project Title: R-M 650 Improvement of Beef Cattle Within Purebreds and Certain of their Crosses Through Breeding Methods Based on Evaluation Tests for Efficiency and Rate of Gain, Heat Tolerance and Carcass Value.

2. Objectives:

   (a) The improvement of beef cattle by selection based on rate and economy of gain, breeding efficiency and carcass value.

   (b) To evaluate cattle with regard to environment, especially heat tolerance.

   (c) To develop strains of beef cattle especially adapted to southern climatic conditions by a breeding program using Brahman cattle and one of the European breeds.

   (d) To improve the carcass value of cattle of predominantly Brahman breeding by introducing characteristics from one of the European breeds.

3. Accomplishments during year:

   (a) Facilities and cattle acquired: Two tested high gaining Herefords were purchased. One, a polled bull from the Georgia Agricultural Experiment Station and the other a heifer from a cooperator at Bluebonnet Farm.

   Three registered Brahman heifers of suitable age for gain testing were purchased.

   A total of 16 registered Red Poll cattle were added to the herd by purchase. These included one mature bull, nine females of breeding age, two heifer calves, and five bull calves.

   Twenty-three registered Brahman heifers of suitable age for gain testing were loaned to Bluebonnet Farm by several Texas breeders for a period of five years.

   Thirty mature, rather old Santa Gertrudis cows on loan to Bluebonnet Farm from King Ranch were replaced by thirty-one Santa Gertrudis heifers of breeding age.

   One tested high gaining polled Hereford bull was loaned to Bluebonnet by the Georgia Agricultural Experiment Station.

   Additional instruments were purchased for measuring atmospheric conditions in connection with heat tolerance studies.

   Feeding pens for gain evaluation testing were expanded to accommodate approximately 30% more cattle. Old facilities were re-worked to facilitate easier handling of cattle. A high capacity industrial type feed grinding mill was purchased and put into operation and buildings and procedures were changed to efficiently utilize this equipment.

Texas Station (continued)

(b) Research Results: This project at Bluebonnet Farm near McGregor, Texas presently includes 425 unregistered and crossbred females, and 99 registered females besides 308 calves and 27 breeding bulls. Of the above, 56 registered Brahman females, 31 unregistered Santa Gertrudis females and 3 breeding bulls are on long time loan to the Experiment Station. Comparisons are being made between registered Brahmans, registered and unregistered Herefords, Santa Gertrudis, Red Polls, crosses between the Brahman and Hereford breeds, and crosses between the Santa Gertrudis and Hereford breeds. Included are calves of the first back-cross generation with the Hereford as the recurrent breed and calves with the Brahman as the recurrent breed. Selections are based primarily on rate of gain, breeding efficiency and weaning weight. Heat tolerance tests have been started and carcass studies continued and are reported below. All selection is aimed directly at performance rather than show ring characteristics.

In addition to the above mentioned breeds and crosses, matings have been made for calves from Hereford cows bred to a Red Poll bull, and F_1 Hereford x Brahman cows bred to Santa Gertrudis and to Red Poll bulls.

All calves raised on the experiment are on test under Project 607, five of which are on test at Balmorhea. In addition to the calves raised here, 28 calves raised by the Texas Agricultural Experiment Station at Barnhart are currently being tested. These 28 calves were sired by a high, a medium and a low gaining bull from the 1952 test at Balmorhea. As controls, there are 67 bulls and heifers entered by private breeders. These visiting calves are of the Hereford, Brahman, Santa Gertrudis, Charbray, and the Charolaise breeds.

All data on gain evaluation testing to date at Bluebonnet Farm have been included in studies of heritability. The results confirm previous estimates, indicating high heritability, and are included in a manuscript which has been prepared for publication as a station bulletin.

Carcass data from 41 Hereford steers and 70 F_1 Hereford x Brahman steers, from three seasons were studied and the few highly significant differences between these breed groups were: dressing percent, length of leg, area of eye muscle and percent of rib cut. The primary purpose of this study was to learn whether the data could be used to evaluate sires and so be used in selection. Eight Hereford and 15 Brahman sires were represented. With our limited numbers no significant carcass differences were found due to sires within breed groups. Heritability estimates from these data were significant only when the Herefords and the crossbreds were combined and not on a within breed basis, indicating that the only heritable differences found are due to breed and these are very limited. From the data studied to date with the small numbers per sire, we are unable to use the data to aid in selection.

Texas Station (continued)

Heat tolerance studies have been initiated and preliminary analysis is partially complete. These data include 366 animal observations in the heat chamber and supplementary field observations. Animals were held in the heat chamber for 8 hours at a temperature of 105 degrees F. and 50% relative humidity. The data show by analysis of various methods, a highly significant difference between breeds or cross (Hereford, Brahman, and Hereford x Brahman crosses) and sexes for body temperature, chamber respiration rate, and pulse rate. Also highly significant differences were found for breed or cross for gain during the summer on unshaded pasture and for respiration rate on pasture. For rectal temperature and chamber respiration rate the Brahmans showed the lowest values. Crossbreds were intermediate and Herefords highest. For pulse rate the crossbreds were highest, Herefords next and Brahmans lowest. For summer gain, the crossbreds were markedly higher and the Brahmans slightly higher than the Herefords.

Repeatability for rectal temperature on successive heat chamber exposures was .47, for chamber respiration rate .62, for pulse rate .32, and for field respiration rate .52.

The relationship between these measures of physiological response to hot atmospheres and several production characters as well as some inter-relationships is shown in the table below.

CORRELATION COEFFICIENTS

(n varies from 219 to 366 except for "color" where n = 75)

		Chamber Resp. Rate	Field Resp. Rate	Winter Ga. 3/ Ratio	Age in Days	Chamber Rel. Humidity	Chamber Body Temp.
Chamber Body Temp.	Overall	.52	.53**	-.09	-.32**	.06	
	Within	.29	.15*	-.06	-.15**	.12*	
Chamber Resp. Rate	Overall		.59**	.05	-.03	.48**	
	Within		.14**	.06	.44**	.34**	
Summer Past. Gain Ratio 1/	Overall	-.23**	.31**	.02			-.22**
	Within	-.05	.05	.02			-.17*
Color 2/	Overall	-.24*	-.46**				-.37**
	Within	.21	-.18				-.15

* indicate statistical significance .05 level.
** indicate statistical significance .01 level.
1/ Summer pasture gain ratio is the gain during the summer months divided by the average of the same sex group for the same period.
2/ Color is scored by visual inspection on a scale ranging from 0 to 100 where 0 = complete black and 100 completely white.
3/ Winter gain ratio is the gain during the winter in the feed lot divided by the average gain of the same sex and breed group.

Texas Station (continued)

4. Future Plans:

These call for continuation of the above program with special emphasis on carcass studies of steers, to determine whether these can be used directly as selection criteria of sires, and special emphasis on heat tolerance tests to learn whether they can contribute directly to the selection.

5. Publications:

The results of the 1952-53 testing program were mimeographed and distributed at the Field Day.

Warwick, B. L., T. C. Cartwright, J. G. Moffitt, M. W. Hazen, G. L. Robertson and O. D. Butler. Detailed Carcass Studies in a Beef Breeding Program. A Summary of Two Years Work. Abs. of paper presented at meeting of South. Agric. Workers, New Orleans, 1953.

Warwick, Bruce L. and T. C Cartwright. Beef Cattle Experiments at Bluebonnet Farm. Paper presented at Second Inter-American Zebu Cattle Congress, San Antonio, 1953.

Warwick, Bruce L. Comparative Carcass Characteristics of Brahman Crossbreds and British Type Cattle. Paper presented at meeting of S-10 Technical Committee, Knoxville, Tenn., 1953.

Butler, O. D. Carcass and Slaughter Data from Bluebonnet Farm Short Fed Yearlings. Presented at Staff Conference of Texas Agric. Expt. Sta., College Station, Oct. 22, 1953.

Cartwright, T. C. Heat Tolerance Studies at Bluebonnet Farm. Presented at Staff Conference of Texas Agricultural Experiment Station, College Station, Oct. 22, 1953.

6. Publications Planned:

A summary of the evaluation testing at Bluebonnet Farm, both Station cattle and cattle belonging to cooperators together with the listing of all bulls by gain and year is now completed and will be offered for publication as a Station bulletin.

PERFORMANCE OF COW HERDS. 1953 CALVES

Texas Station
Bluebonnet Farm

Line or group designation	Hereford	Brahman	Backcross	Crossbred F_1	Backcross	Crossbred
Breed of sire	Hereford	Brahman	Hereford	Brahman	Brahman	Santa Ger.
Breed of dam	Hereford	Brahman	Crossbred (F_1 HxB)	Hereford	Crossbred (F_1 HxB)	Hereford
No. bred - Cows:	96	31	16	163	17	29
Yearling Heifers:	26*	8*	23*		24*	
No. cows calving	93	30	32	118	34	20
No. calves raised	85	25	30	108	29	19
Av. birth wt. (lbs)	70	66	70	81	73	77
Av. birth date	3-8-53	3-22-53	3-30-53	3-11-53	3-28-53	3-3-53
Were calves creep fed?	No	No	No	No	No	No
Av. wt. 6 mo. (lbs)	349	363	402	385	401	397
Av. weaning date	10-28-53	10-28-53	10-28-53	10-28-53	10-28-53	10-28-53

* Exposed for breeding for approximately 1 month only.

PRODUCTION AND SLAUGHTER DATA ON YEARLING CATTLE
NOT INCLUDED IN BREEDING HERDS IN 1953

Texas Station
Bluebonnet Farm

Breeding	Crossbred	Hereford	Crossbred
Sex	Steers	Steers	Bulls
No.	16	8	8
Days on feed	170	170	170
Av. daily gain on feed	1.6	2.0	2.2
Av. age at slaughter (days)	418	452	460
Av. slaughter weight	698	743	866
Av. dressing percent	61.6	59.7	61.1
Av. carcass grade*	7.8	5.5	7.1

* Scale: 1 = High Choice, 2 = Av. Choice, 3 - Low Choice, 4 = High Good, 5 = Av. Good, 6 = Low Good, 7 = High Commercial, 8 = Av. Commercial, 9 = Low Commercial

1. Project Title: RM-714 Methods for Measuring Potential Efficiency of Feed Utilization in Immature Beef Cattle.

2. Objectives:

The objective of this project is to develop methods of a biochemical or physiological nature which will measure, in the immature animal, the potential efficiency of the utilization of feed in building body tissues.

This objective has been pursued by essentially two methods of attack. A search for chemical constituents in blood which vary with the variation in rates of gain and efficiency of feed utilization and, secondly, a search for biochemical factors which are characteristic of the individual animal with an attempt to correlate these findings with rates of gain.

3. Accomplishments during year:

(a) Facilities and cattle acquired: No new facilities have been acquired for specific use for this project. The facilities and cattle of the Department of Animal Husbandry, Texas A. and M. College, are now being used for the work at College Station. Cattle used in the tests completed during the earlier part of the year were loaned by cooperative breeders.

Nine dwarf Hereford bulls have been purchased for experiments presently underway.

(b) Research results: Studies on the relationship of the level of serum protein-bound iodine (PBI) to rates of gain have been continued using over 150 Hereford and Angus beef calves, including bulls, steers and heifers, 8-14 months of age, in 4 feeding trials. Additional evidence was obtained which indicated that there is an optimum level of PBI commensurate with good subsequent feed lot gain. Using the alkali incineration method of Barket et al. for the determination of protein-bound iodine the optimum level of serum PBI appears to be about 5.5 mg. of PBI per 100 ml. of serum. There appears to be no sex difference in this optimum.

An optimum range of PBI has been tentatively set at 5.0 to 6.5 μg per 100 ml. of serum. It is to be expected that many animals whose PBI levels fall within the "optimum" range will not give a good response in the feed lot because there are physiologic factors other than thyroid activity known to control growth rate as well as environmental factors. This is evident from the experimental data, but at the same time, the fastest gaining animals (top 20%) consistently had PBI levels which fell within the "optimum" range.

Since the evidence described above was obtained with samples taken within the first 2 weeks of each feeding trial, it is believed that the serum protein-bound iodine test will form a basis for development of a biochemical method of measuring potential rate of gain in immature Hereford and Angus cattle. Other factors must be accounted for before a correct evaluation of the significance of PBI level can be made.

Two blood constituents, glutathione and serum alkaline phosphatase, have been found to vary with breed individuals. The level of blood glutathione appears to be a characteristic of the individual with repeatabilities ranging from 0.74 to 0.99 with repeated samples taken from particular groups of animals. The blood glutathione of Angus consistently runs higher than that of Herefords. No correlation with growth rate has been obtained with glutathione.

The serum alkaline phosphatase activity was determined in 300 cattle. The average phosphatase activities of Brahman cattle was found to be approximately twice that of European breeds of the same age. The European breeds which were studied included the Angus, Hereford, Jersey and Holstein breeds and no differences between these breeds were noted. No significant differences with sex were noted.

The correlation coefficient between initial phosphatase in Angus and Herefords and subsequent gain was -0.19. The phosphatase levels at the end of the feeding trial, however, were negatively correlated with factors affecting rate of gain, efficiency of feed utilization and feed intake.

With the Brahman cattle, the use of the serum alkaline phosphatase activity shows promise of being a measure of the potential rate of gain. In a test with 24 Brahman bulls at Bluebonnet Farm, the correlation between the initial serum alkaline phosphatase and subsequent gains was 0.84, a correlation which is highly significant. While no significant correlation was obtained with 14 Brahman heifers, when sire groupings were compared, the sire groups with the higher phosphatase were the higher gaining groups.

No significant correlation between phosphatase and subsequent rate of gain has been found in Angus, Hereford and Brahman-Hereford crossbred animals.

4. Future Plans:

The study of the relationship between the serum protein-bound iodine level and serum alkaline phosphatase activity and the subsequent gain will be continued with the cooperation of personnel of the Department of Animal Husbandry, Bluebonnet Farm, and Pan Tech Farms.

Attention will be turned to the steriod hormones as possible indicators of potential feed lot performance. Methods for the estimation of these hormones in the blood are now appearing in the literature and it is anticipated that considerable effort will be made toward development of a method which may be used with bovine blood.

A study of the heritability of various blood constituents will be initiated. It is hoped that a program of fundamental research on metabolic interactions may be initiated.

5. Publications:

Kunkel, H. O., R. W. Colby and C. M. Lyman. The Relationship of Serum Protein-bound Iodine Levels to Rates of Gain in Beef Cattle. Jour. An. Sci. 12: 3, 1953.

Burns, K. H., R. W. Colby, P. Gougler, and H. O. Kunkel. Correlation Between Serum Protein-bound Iodine Levels and Metabolic Rates in Male Bovine. Am. Jour. Physiol., 172: 107, 1953. (Note: The above appeared during the year but previously have been reported in the Annual Report.)

Kunkel, H. O., D. K. Stokes, Jr., W. B. Anthony, and M. F. Futrell. Serum Alkaline Phosphatase Activity in European and Brahman breeds of Cattle and Their Crossbred Types. Jour. An. Sci., 12: 766, 1953.

Stokes, D. K., Jr., M. R. Futrell, and H. O. Kunkel. Further Studies on the Relationship of Serum Protein-bound Iodine Levels to Rates of Gain in Beef Cattle. Jour. An. Sci. 12: 897, 1953 (Abs.)

6. Publications Planned:

No manuscripts are in preparation at present. A publication based upon studies on the relationship with protein-bound iodine to gain is anticipated during the latter part of the year.

VIRGINIA STATION

Submitted by C. M. Kincaid, December, 1953

Beef cattle breeding work in Virginia is conducted at three locations. The state stations are at Blacksburg and Middleburg, while the work at Front Royal is on property owned by the United States Department of Agriculture and is cooperative between that agency and the Virginia Experiment Station. All work in the state is integrated under one project and there is a considerable interchange of breeding stock between stations from time to time.

1. Project Title: The Improvement of Beef Cattle Through Breeding Methods.

2. Objectives:

(a) To study the productivity of stocks of beef cattle now used in Virginia.

(b) To develop methods for estimating the breeding value with respect to type, growth rate and efficiency of young bulls.

(c) To establish, maintain and develop herds of beef cattle within the pure breeds that will be highly adapted to the Appalachian region, as measured by their ability to utilize grass and rations with limited concentrates, in the efficient production of animals which yield high quality carcasses of desirable type and conformation.

(d) To estimate the progress to be expected from mass selection as compared with family selection in the improvement of beef cattle.

(e) To evaluate selection criteria and procedures and develop more precise and effective measures of quality and performance in beef cattle.

(f) To simplify the methods of progeny or sib testing whereby breeding cattle can be evaluated at comparatively young ages.

3. Accomplishments during year:

(a) Facilities and cattle acquired: The total cattle numbers in the program are about the same as last year. The addition of females raised and purchased permitted the replacement of 32 cows formerly owned on a share basis, and 50 grade Herefords at Front Royal. With all stations stocked to capacity, emphasis has been on the development of research herds that fit long-time plans. No material change in land and buildings has taken place in the past year, but feeding lots for group testing at all stations have been increased and improved.

Virginia Station (continued)

(b) Research results:

Performance Testing

Performance tests have been continued at both Blacksburg and Front Royal with both individual and group feeding. Individual feeding tests with bull calves for six months after weaning provided potential foundation sires in each of the three breeds and fast and slow gaining bulls for progeny testing. Heifer calves at Front Royal were group-fed on a ration containing approximately 3-1/2 pounds of concentrates, 2-1/2 pounds of hay, and silage free choice. As shown in the tabular material, average daily gains were very good for a ration this high in roughage. Steer calves in the fast and slow gaining bull test at Blacksburg were individually fed in somewhat the same way as in previous years. The heifer calves in this same test at Blacksburg were individually fed on wintering rations and finished on pasture alone.

A cooperative program with ten breeders in the state in which weights and grades are obtained on calves at approximately three months intervals was started. Three hundred fifty-seven calves have been entered in this program up to December 1, 1953. A portable scale is used for the weighing, and experience up to now indicates that such a program is feasible.

Analysis of the data for the steer and bull feeding work since 1948 shows heritability of growth rate based on gains in dry lot after weaning and measured as the actual achievement from selection to be approximately 22 per cent. Weight at six months of age shows somewhat the same relative performance as was found in post weaning trials. In general, sire progenies that were slow gainers in the post weaning trials were also the lightest at six months old. Grazing tests with the heifers after winter gains of 1/2 to 3/4 of a pound per day showed heritability of growth rate to be approximately 15 per cent.

Feeding tests with bull calves for six months after weaning have shown rather wide variability in rate of gain within breeds and within sets of half sibs fed out in the same year. In general, the average rate of gain for bulls of the three breeds - Angus, Hereford, and Shorthorn - has been somewhat the same, with gains ranging from less than 1-1/2 pounds to almost 3 pounds per day for the entire feeding period. The correlation between type score and rate of gain has been quite low and indicates little or no relation between these two traits. The data indicate that selection for either type or rate of gain may have little effect on the other characteristic. The results also suggest that prior treatment and condition at the beginning of the trial may influence rate of gain and efficiency in the feedlot. Other things equal, the thinner animals tend to make the greatest gains and the fatter ones the least gains where they are self-fed on the same ration.

Foundation Herds

In addition to the two foundation herds in the Shorthorn breed, established in 1951, matings were made in 1952 toward the

establishment of an additional set of foundation females in each of the three breeds at Front Royal. With this station now stocked with about as many breeding cows as it will carry, it is planned to replace production females with foundation females as rapidly as replacements sired by foundation bulls will permit.

The Middleburg herd of Aberdeen Angus cows is to be handled entirely on forage crops and pastures throughout the year with selection for performance under these feed conditions. This herd will be kept at about its present size of 50 females.

Measurement of Performance

The use of an index giving equal emphasis to weight for age and type score for selection of potential replacements has been continued. This index appears, from visual inspection of groups selected, to be a satisfactory tool.

An analysis was made of body measurements, type scores and record of performance data from 66 heifers born in 1952 at the Front Royal Station. The findings of this study were published in the report of the Annual S-10 Technical Committee Meeting held at Knoxville, Tennessee August 31, 1953. These data indicated that measurements and type scores of new-born calves were of little value in predicting future growth and performance. In general, correlations between type scores and linear measurements at 12 months of age were 0.50 or less. Correlations between type score and certain ratios of linear measurements showed the highest correlation ($r = 0.67$) between type score and $\frac{\text{depth of chest}}{\text{height at crops}}$.

A study was made of certain factors that may influence feed intake and have a bearing on the measurement of efficiency in beef cattle with data from individual feeding tests of 66 steers and 121 bulls. Variations in weight accounted for 35 percent of the total variance of feed consumption. The correlation between gain and gross efficiency ranged from -0.05 to 0.63, but when feed consumption was adjusted for weight, the correlation ranged from 0.77 to 0.88. It was concluded that the ratio of feed consumption to gain had little value as a measure of efficiency unless the animals being compared were of equal weight or had their feed consumption adjusted for differences in weight. After the first 56 days of the feeding period, daily gain within animal was somewhat the same from period to period over the age range from 12 to 18 months. Average daily gain appeared to be independent of weight and a satisfactory measure of efficiency. However, the study indicated that individual feeding provided the maximum information.

4. Future Plans:

At the Blacksburg Station, the progeny testing of fast and slow gaining bulls will be discontinued in 1954. It is tentatively proposed to replace this work with an investigation of crossbreeding using the three major breeds of beef cattle. If this work is initiated, it will provide comparisons among straight bred, crossbred,

Virginia Station (continued)

back cross and three way cross calves raised by the same kind of dams and also between straight bred and cross bred dams raising calves bred the same way. The new Southwest Virginia Research Station will include in its program a part of this cross breeding experiment. The transition from the bull testing experiment to the cross breeding experiment will probably start in the fall of 1954.

At Front Royal, cows now in the production herds will be replaced as rapidly as possible with cows sired by foundation bulls in order to have all cows in the herds contributing as early as possible to the long-time research on breeding methods. It is planned to breed approximately 400 cows at this station in 1954.

At Middleburg, work will be continued on the development of a herd of Angus cattle selected for performance from pasture and roughages. Potential young sires and heifers for replacement will be tested for performance from pastures and roughages with herd replacements determined by the results of these tests.

Cooperative performance tests of cattle in the herds of breeders will be expanded in 1954 if additional funds and personnel are made available. It is proposed to add to the program both Aberdeen Angus and Hereford breeders.

5. Publications:

Grizzle, James E. The Relationship Between Body Weight, Daily Gain and Efficiency of Feed Utilization in Beef Cattle. M. S. Thesis, Virginia Polytechnic Institute, 1953.

Kincaid, C. M., R. C. Carter and J. S. Copenhaver. Heritability of Rate of Gain from Progeny Tests with Beef Cattle. Proc. South. Agric. Workers Assn., New Orleans, Louisiana, 1953.

6. Publications Planned:

R. C. Carter - Heritabilities of Gain and Grade in Beef Cattle. Ph.D. Thesis, Iowa State College.

Journal Article - Progeny Tests of Fast and Slow Gaining Bulls.

Station Bulletin - On results of Sire Testing.

Brochure - Beef Cattle Research Station, Front Royal, Virginia.

RECORD OF PERFORMANCE TEST OF 1952 PUREBRED CALVES
FULL FED AFTER WEANING

Virginia Station
Front Royal

Breeding of calves	Angus	Hereford	Shorthorn
Bulls, No.	15	16	16
Av. weaning wt.	579	439	478
Av. 12 mo. wt.	780	772	819
Length of feeding period	167	167	167
Feed per cwt. gain (lbs)**	959	797	838
Av. daily gain on test	2.18	2.03	2.37
Av. type score (12 mo.)***	11.2	10.9	11.1
Heifers, No.	19	20	28
Av. weaning wt.	445	337	393
Av. 12 mo. wt.	572	474	554
Length of feeding period	80	80	80
Feed per cwt. gain (lbs)*			
Av. daily gain on test	1.94	1.77	2.32
Av. type score (12 mo.)***	12.5	9.8	11.5

* Cannot be obtained separately for each breed; heifers were fed in mixed lots on a full feed of ensilage and approximately 6 pounds of mixed feed per head per day. (40% hay, 40% ear corn, and 20% supplement)

** Feed mixture was 40% hay, 50% ear corn, and 10% supplement in the first half of the feeding period; and 25% hay, 65% ear corn, and 10% supplement in the last half.

*** All scores in Virginia report on scale 6-8 = Medium; 9-11 = Good; 12-14 = Choice.

PRODUCTION DATA ON YEARLING HEIFERS
1953

Virginia Station
Front Royal

Breeding:	Angus	Heref.	S'horn	Heref.	S'horn
Sex	F	F	F	F	F
No.	19/1	20/1	28/1	19	9
Av. age (fall 1952)	7 mo.	7 mo.	7 mo.	7 mo.	7 mo.
Av. wt. (fall 1952)	445	337	393	322	358
Av. winter gain	155	142	186	73	61
Days on pasture	160	166	160	172	172
Av. gain on pasture	46	111	48/3	165	198/4
Days on feed	/2	/2	/2	/5	/5

/1 These are the same heifers included in preceding table.
/2 Were not fed after pasture season.
/3 For 25 heifers only; one died and no weights obtained on two.
/4 Includes only 8 heifers.
/5 Wintered on limited ration of ensilage, hay, and cottonseed meal.

RECORD OF PERFORMANCE TEST OF 1952 STEERS ON FULL FEED* SIRED BY FAST AND SLOW GAINING BULLS

Virginia Station
Blacksburg

Line or group designation	Fast A (OE240)	Slow A (A100)	Fast B (Af140)	Slow B (FR110)	Fast C (V934)	Slow C (FR05)	Fast D (023)	Slow D (M-24)
Breeding	A x H	A x H	A x H	A x H	Gr. H.	Gr. H.	Gr. H.	Gr. H.
No.	5	5	5	5	3	3	5	3
Av. wean. wt.	453	466	458	498	388	427	456	495
Av.6mo. wt.	372	376	409	400	346	337	425	445
Av.12 mo. wt.	702	691	702	695	614	602	682	720
Feeding period:								
No. days	215	215	215	215	215	215	193	193
Feed per cwt. gain (lbs)								
Grain	594	593	590	661	521	571	557	564
Roughage	452	454	448	510	388	435	438	443
Daily gain	1.73	1.73	1.69	1.52	1.54	1.38	1.69	1.82
Type score (Initial)	11.2	12.2	11.8	12.4	11.7	12.4	11.4	10.3
Cond.score (Final)	12.6	13.1	11.4	11.8	9.9	8.6	13.2	11.1
Animals slaughtered:								
Av.final age	437	438	424	443	423	446	414	418
Av. live wt.	824	838	822	824	720	722	803	896
Av. carcass wt.	452	501	459	487	406	409	466	522
Av. offal wt.	372	337	363	337	314	293	337	374
Av. carcass grade	10.8	12.0	10.8	11.8	9.7	7.7	10.4	9.3

* Feed mixture was 40% hay, 50% ear corn and 10% oil meal the first half of the feeding period; 25% hay, 65% ear corn and 10% oil meal the last half.

PRODUCTION AND SLAUGHTER DATA ON YEARLING HEIFER PROGENIES
OF FAST AND SLOW GAINING BULLS
1953

Virginia Station
Blacksburg

Line or group designation	Fast A (OE240)	Slow A (A100)	Fast B (Af140)	Slow B (FR110)	Fast C (V934)	Slow C (FR05)
Breeding	A x H	A x H	A x H	A x H	Gr. H.	Gr. H.
No.	10	8	7	5	3	7
Av. age (fall '52)	218	210	230	222	213	218
Av. wt. (fall '52)	444	406	476	443	425	371
Av. winter gain/1	109	94	103	86	88	60
Days on pasture	183	183	183	183	183	183
Av. gain on pasture	330	297	354	325	316	264
Av. wt. adjusted to 18 mo. of age	803	742	846	777	769	626
Animals slaughtered:						
No.	6	5	5	4	3	1
Av. age at slaughter	583	575	595	587	578	583
Av. slaughter wt.	895	808	943	852	829	846
Av. slaughter grade	10.4	9.7	10.3	9.8	9.1	9.7
Av. dressing percent	51.8	53.1	53.1	52.3	53.8	53.2
Av. carcass grade	8.3	8.6	8.8	8.0	7.7	8.0

/1 Wintered on a daily ration of 4 pounds of mixed hay, 8 pounds of corn silage, and 3 pounds of supplement containing 30 per cent protein.

PERFORMANCE OF 1952 FALL CALVES GRAZED ON PASTURE ALONE IN 1953

Virginia Station
Middleburg

Line	Eil.	Epp.	Eil.	Epp.
Breed	Angus	Angus	Angus	Angus
Sex	Steer	Steer	Heifer	Heifer
Number	6	5	5	7
Age (Spring 1953)	249	259	244	259
Weight (Spring 1953)	465	413	462	431
Age (Fall 1953)	412	422	407	422
Weight (Fall 1953)	691	618	669	639
Days on pasture	163	163	163	163
Gain on pasture	226	205	207	217
Wt. 12 mo. old	629	555	597	568

PERFORMANCE OF PUREBRED COWS IN TEST HERDS - 1953 CALVES

Virginia Station

Line or group designation	Test	Test
Location	Middleburg	Middleburg
Sire No.	Eileenmere	Epponian
Breed of sire	Angus	Angus
Breed of dam	Angus	Angus
No. cows bred	27	27
Cows calving	22	25
Calves raised	14	18
Birth wt.	62	58
Birth date	8-3	8-1
Creep fed?	No	No
6 mo. wt.	380	339
Weaning date	4-14	4-14
Weaning weight	455	404
Wean. type score*		
Wean. cond. score*		

*Scores not available.

PERFORMANCE OF COWS IN FOUNDATION HERDS - 1953 CALVES

Virginia Station
Front Royal

Line or group designation	A-1	B-2	Type	Growth
Sire no.	868	663	114	834
Breed of sire	Shorthorn	Shorthorn	Shorthorn	Shorthorn
Breed of dam	Shorthorn	Shorthorn	Shorthorn	Shorthorn
No. cows in herd	16	15	13	15
No. cows calving	11	7	7	7
No. calves raised	9	7	7	6
Av. inbr. of dams (%)	8.0	9.4	10.8	9.7
Av. inbr. of calves (%) *				
Av. birth wt. (lbs)	69	72	75	66
Av. birth date	2-28	3-5	3-5	3-14
Were calves creep fed?	No	No	No	No
Av. wt. 6 mo. (lbs)	318	359	343	340
Av. weaning date	9-21	9-21	9-21	9-21
Av. weaning wt.	341	376	361	330
Av. wean. type score	9.0	11.0	11.2	10.6
Av. wean. cond. score	7.9	9.5	10.0	9.0

* Has not been calculated.

PERFORMANCE OF PUREBRED COWS IN TEST HERDS - 1953 CALVES

								Virginia Station Front Royal				
Line or group	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test
Sire no.	T-44	116	06	31	52	441	EE 18	040	057	59	140	171
Breed	S'horn	S'horn	Heref.	Heref.	Heref.	Heref.	Angus	Angus	Angus	Angus	Angus	Angus
Cows in herd	32	27	34	40	32	19	9	12	10	15	34	4
Cows calving	24	17	19	34	21	15	9	9	9	13	26	4
Calves raised	23	14	18	33	21	14	8	10	8	12	25	4
Inbreeding dams*												
Inbreeding calves*												
Birth wt.	68	71	70	67	67	67	57	54	64	64	60	66
Birth date	3-13	3-24	3-15	3-6	3-16	3-8	1-11	3-11	3-20	3-20	3-3	4-21
Creep fed?	No	No	No	No	No	No	No	No	No	No	No	No
6 mo. weight	309	348	370	334	359	348	366	368	381	414	402	345
Weaning date	9-21	9-21	9-23	9-23	9-23	9-23	9-29	9-29	9-29	9-29	9-29	9-29
Weaning weight	319	348	381	354	369	371	499	398	396	428	446	296
Wean.type score	10.2	11.0	10.2	11.7	11.1	11.3	11.9	12.1	12.0	12.7	11.3	9.8
Wean.cond.score	8.5	9.5	9.2	10.2	10.0	10.1	11.2	10.8	10.6	11.0	10.2	8.7

*Has not been calculated.

PERFORMANCE OF COW HERDS TO PROGENY TEST FAST AND SLOW GAINING BULLS - 1953 CALVES

Virginia Station
Blacksburg and Front Royal

Line or group designation	Fast (A-251)	Slow (A-190)	Fast (HB19)	Slow (HL10)	Fast (SH862)	Slow (SH66)	Fast (023)	Slow (M-24)
Location	(- - - - - - Blacksburg Station - - - - - -)						(Front Royal)	
Breed of sire	Angus	Angus	Heref.	Heref.	S'horn	S'horn	Heref.	Heref.
Breed of dam	Gr. H.	Gr. H.	Gr. H.	Gr. H.	Gr. H.	Gr. H.	Gr. H.	Gr. H.
No. cows bred	20	17	16	12	15	17	29	31
No. cows calving	16	15	13	11	14	14	23	23
No. calves raised	16	15	13	10	14	13	21	22
Av. birth wt.	77	74	82	66	77	72	68	70
Av. birth date	3/16	2/27	2/27	3/2	2/27	2/23	2/28	2/25
Creep fed?	No	No	No	No	No	No	No	No
Av. wt. 6 mo.	418	382	396	382	406	360	343	311
Av. weaning date	9/22	9/22	9/22	9/22	9/22	9/22	9/23	9/23
Av. weaning age	190	208	206	204	206	211	207	210
Av. weaning wt.	428	426	442	414	454	403	367	340
Av. wean. type score	12.3	12.0	12.2	11.0	11.8	10.0	-	-
Av. wean. cond. score	11.2	10.8	10.8	10.0	10.8	10.2	-	-

E. J. Warwick.

S-10, IMPROVEMENT OF BEEF CATTLE FOR THE SOUTHERN REGION THROUGH BREEDING METHODS

- Report of -

Annual Meeting S-10 Technical Committee

Held at Raleigh, North Carolina

September 7-9, 1955

State Experiment Stations of Alabama, Arkansas, Georgia, Florida, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Texas and Virginia in cooperation with the Animal and Poultry Husbandry Research Branch, Agricultural Research Service, U. S. Department of Agriculture. This report is intended for the use of administrative leaders and workers in developing the program and is not for general distribution.

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TABLE OF CONTENTS

1955 -- S-10 Executive Committee

Chairman - Marvin Koger
Secretary - Bruce L. Warwick
Member at Large - R. A. Damon, Jr.
E. J. Warwick - Regional Coordinator to August 31, 1955
R. E. Patterson - Administrative Advisor

1955 S-10 TECHNICAL COMMITTEE MEETING

The 1955 S-10 Technical Committee Meeting was held in North Carolina September 7-9, 1955. The 9th was devoted to an optional trip to the North Carolina Test Farm at Plymouth and to the Frying Pan Range near Columbia to observe experimental cattle.

The formal meeting of the group at Raleigh was called to order by Chairman Marvin Koger at 8:30 a.m., September 7. Chairman Koger introduced Dr. H. A. Stewart of the North Carolina Station who presented Dean D. W. Colvard. In the absence of Dr. R. E. Patterson, Dr. E. J. Warwick was asked to respond to Dean Colvard's welcome.

The question was discussed as to the place of meeting in 1956 and whether it would be combined with a Statistical Workshop meeting. Invitations were extended by Florida, Georgia, Arkansas and Texas. No action was taken at this time.

Each person present was asked to introduce himself. One foreign visitor, Mr. David Levy, in charge of all beef cattle breeding work in Israel, was in attendance. The statistical workshop in the Western Region held last year was discussed by Dr. W. R. Harvey.

The following Technical Committee members and guests were present (Technical Committee members designated by *, acting by **):

* W. M. Warren, Ala. Agr. Exp. Station, Auburn, Alabama
* Warren Gifford, Ark. Agr. Exp. Station, Fayetteville, Arkansas
* Marvin Koger, Florida Agr. Exp. Station, Gainesville, Florida
J. L. Carmon, University of Georgia, Athens, Georgia
J. M. Clyburn, Georgia Agr. Exp. Station, Reedsville, Georgia
W. C. McCormick, Georgia Agr. Exp. Station, Tifton, Georgia
C. C. O'Mary, University of Georgia, Athens, Georgia
* B. L. Southwell, Georgia Agr. Exp. Station, Tifton, Georgia
E. P. Warren, University of Georgia, Athens, Georgia
* R. A. Long, University of Kentucky, Lexington, Kentucky
* R. A. Damon, Jr., Louisiana Agr. Exp. Station, Baton Rouge, Louisiana
* W. W. Green, Maryland Agr. Exp. Station, College Park, Maryland
John A. McGuire, Mississippi Agr. Exp. Station, Starkville, Mississippi
** L. C. Ulberg, Mississippi Agr. Exp. Station, Starkville, Mississippi
J. L. Cason, North Carolina Agr. Exp. Station, Raleigh, North Carolina
Lemuel Goode, North Carolina Agr. Exp. Station, Raleigh, North Carolina
J. H. Gregory, North Carolina Agr. Exp. Station, Raleigh, North Carolina
* E. U. Dillard, North Carolina Agr. Exp. Station, Raleigh, North Carolina
J. W. Patterson, North Carolina Agr. Exp. Sta., Raleigh, North Carolina
J. W. Pou, North Carolina Agr. Exp. Station, Raleigh, North Carolina
H. A. Stewart, North Carolina Agr. Exp. Station, Raleigh, North Carolina
** W. C. Godley, South Carolina Agr. Exp. Station, Clemson, South Carolina
** H. J. Smith, Tennessee Agr. Exp. Station, Knoxville, Tennessee
T. C. Cartwright, Texas Agr. Exp. Station, McGregor, Texas
H. O. Kunkel, Texas Agr. Exp. Station, College Station, Texas
* Bruce L. Warwick, Texas Agr. Exp. Station, McGregor, Texas
R. C. Carter, Virginia Agr. Exp. Station, Blacksburg, Virginia
* C. M. Kincaid, Virginia Agr. Exp. Station, Blacksburg, Virginia

Martin J. Burris, Virginia Agr. Exp. Station, Front Royal, Virginia
J. C. Taylor, Virginia Agr. Exp. Station, Blacksburg, Virginia
T. J. Marlowe, Virginia Agr. Exp. Station, Blacksburg, Virginia
Walter R. Harvey, U.S.D.A. Biometrical Services, Beltsville, Maryland
M. W. Hazen, U.S.D.A., Brooksville, Florida
E. H. Vernon, U.S.D.A., Jeanerette, Louisiana
E. J. Warwick, U.S.D.A., Beltsville, Maryland
B. M. Priode, U.S.D.A., Front Royal, Virginia
James O. Grandstaff, Office of Exp. Stations, Washington, D. C.
William E. Shaklee, Office of Exp. Stations, Washington, D. C.
David Levy, Neve-Yhar Expt. Station, Israel

The chairman appointed the following as the Resolutions Committee:

Warren Gifford, Chairman
W. W. Green
B. L. Southwell

The following reports were presented and discussed:

Kentucky)
Maryland)
South Carolina) See following pages for
Tennessee) mimeographed reports
Texas)
Virginia)
North Carolina)

The following persons presented the report material from the respective states:

Kentucky	R. A. Long
Maryland	W. W. Green
South Carolina . .	W. C. Godley
Tennessee.	H. J. Smith
Texas	Bruce L. Warwick, T. C. Cartwright and H. O. Kunkel
Virginia	C. M. Kincaid, Martin Burris, R. C. Carter and T. J. Marlowe
North Carolina . .	E. U. Dillard

The rest of the afternoon was devoted to a trip to the barns and pastures of the North Carolina Station at Raleigh, directed by E. U. Dillard.

Kentucky Report

R. A. Long and D. G. Steele

I. Project Title: A Performance and Progeny Testing Program for Bulls of of the Beef Breeds.

II. Objectives: To use weaning weights, rate of gain, efficiency of gain, conformation, and condition of bull calves in an effort to determine what weight these items should receive in predicting the value of bulls in the breeding herd.

III. Accomplishments:

(1) A 154 day performance test was completed on 15 bulls (7 Herefords, 6 Angus, and 2 Shorthorns) the data from which is presented in Table I. Fifteen more bulls (5 Herefords, 7 Angus, and 3 Shorthorns) have already been started on an identical test.

(2) The breeding dates on all brood cows in the University herd have been changed from a year around program to a $2\frac{1}{2}$ months breeding season for early spring calves so that comparisons within breeds and between breeds can be made.

(3) Four bulls from the first performance test (two high gaining and two low gaining bulls) are being compared as to gain on pasture. At the end of this grazing period a 10 day preliminary and 10 day fecal collection period will be run using chromic oxide as an indicator in order to compare the digestibility of protein, fat and fiber.

IV. Design of Performance Test:

Purebred beef bulls are used in the test and may be nominated by any Kentucky breeder. A fee of $125.00 per head provides feed, care, and veterinary expenses for a six-months period. The bulls are allowed a two or three weeks period to become accustomed to their surroundings and the ration fed. Detailed records are kept on feed consumed and rate of gain for a period of 150 days. The bulls are individually self-fed a pelleted ration of the following formula:

Ground shelled corn	23.2%
Ground oats	23.2%
Wheat bran	5.8%
Linseed oil meal	5.8%
Blackstrap molasses	7.2%
Alfalfa meal	11.6%
Ground Timothy Hay	23.2%

In addition the bulls have access to loose salt, ground limestone, steamed bonemeal, and fresh water. At the beginning and the end of each test the bulls are rated by a committee as to conformation and degree of finish. Photos are also taken behind a six inch grid so

that body measurements may be compared with various other data. At the end of the test the bulls are returned to their owners for sale or for use in the breeding herd.

V. Future Plans:

(1) Two 154 performance tests will be conducted each year.

(2) Four bulls from the first performance test (bulls 8, 9, 10 and 11 in Table I) will each be mated with 25 grade Hereford cows during the summer of 1956 and the calves from these matings compared after weaning as to feed lot performance and carcass value. These cows will be lotted as uniformly as possible as to age, conformation and previous weaning weights of their calves.

Table I

Kentucky

Breed and Identification No.	Initial Wt. Lb.	Final Wt.Lb.	Av. Da. Gain Lb.	Feed/cwt. Gain, Lb.	Age at End of Test,days	Weight* For Age	Average Score** Conformation	Average Score** Condition	Breeder
Angus - 2	638	1017	2.46	733	396	2.57	1 -	Low Prime	C. V. Whitney
Angus - 3	627	967	2.21	771	403	2.15	2	Low Ch.	"
Angus - 4	525	865	2.21	616	367	2.36	2 -	High Good	"
Angus - 5	642	1025	2.49	866	396	2.59	2	Low Ch.	"
Angus - 6	667	993	2.12	722	396	2.51	2	Av. Ch.	"
Angus - 7	548	830	1.83	744	372	2.23	3	High Comm.	"
Hereford - 8	653	1037	2.92	643	505	2.05	1 -	High Ch.	C. B. McCord Winchester
Hereford - 9	698	1062	2.36	787	506	2.10	2 +	Av. Ch.	"
Hereford - 10	760	1207	2.90	771	507	2.38	1 -	High Ch.	"
Hereford - 11	637	990	2.29	737	493	2.00	2 -	Av. Good	J. D. Gay, Jr. Pine Grove
Shorthorn - 12	640	1052	2.68	758	464	2.26	2 -	High Good	James Kirk Maysville
Shorthorn - 13	555	1000	2.89	671	414	2.41	2 -	High Good	"
Hereford - 14	625	1103	3.10	637	445	2.48	2	Av. Ch.	Laban Jackson Shelbyville
Hereford - 15	758	1230	3.06	819	444	2.77	2	Av. Ch.	"
Hereford - 16	530	977	2.90	607	441	2.21	2 -	Av. Good	"
Averages			2.56	725		2.34			

* Final weight divided by days of age.
** Scored from 1 + to 3 - with 1 + as the most desirable as to conformation.
***This grade ignores conformation and indicates a degree of finish carried by a typical slaughter steer of the same grade.

Maryland Report

W. W. Green

Project C-14

I. Title: A STUDY OF THE PRODUCTIVENESS OF PUREBRED BEEF CATTLE IN MARYLAND*

II. Objectives:

(1) To study productiveness of existing or introduced stocks of beef cattle. Productive characteristics measured will include rate of gain, economy of gain, market type, carcass quality, fertility, longevity, adaptation to environmental conditions and other factors affecting the utility value of beef cattle.

(2) To compare selection criteria (individual and pedigree) with actual performance of progeny.

(3) To evaluate breeding techniques for small purebred herds under the varying conditions encountered in practice in purebred herds.

(4) To attempt to produce beef cattle with superior productive capacities by linebreeding and selection. (Using criteria of selection as developed in this project and by cooperating stations in this and other regions.)

III. Accomplishments:

A. Semi-annual weights of all cattle and birth weights of all calves have been secured from the Aberdeen-Angus herd of one cooperator from 1949 through the fall of 1954. The herd was sold and cooperation terminated in the spring of 1955. A study involving the use of birth and other weights for the estimation of 180-day weights has been reported in progress reports. No additional analysis of any of the data has been undertaken.

B. Cooperative work involving the weighing and scoring (see Project C-14-b) of two sets of Aberdeen-Angus bull calves in a rate of gain study was initiated in the fall of 1954 by the addition of a new cooperator to the project. The reasons for undertaking the work, from a research standpoint, involved (a) objective No. 1 of this project and (b) a study of problems which might be encountered in doing such work under practical farm conditions.

Twenty-eight calves were weaned, weighed, (and scored) and started on trial on October 31, 1954. They were weighed on January 28, 1955, and weighed (and scored) on March 31, 1955, (set No. 1 calves). Set

* A sub-project to the Southern Regional Beef Cattle Breeding Project entitled "The Improvement of Beef Cattle for the Southern Region Through Breeding Methods." (To supplement primarily objective 5, although to some extent objective 1.)

No. 2 calves involved 25 young bulls which were weaned during December 1954 and early January 1955, weighed (and scored) and placed on trial January 28, 1955. Weights (and scores) were taken on March 31 and June 8, 1955. All calves were self-fed a good growing ration and were treated the same, within sets.

Much, but not all, of the data has been analyzed. Means and standard deviations are given in Table 1. It is of importance to state that the condition ratings of the animals on a calf-by-calf comparison, were, with but one or two exceptions, identical at the start and finish of the feeding periods within each set of calves and that the ratings on a between-set comparison were very similar. All of set 1 had condition ratings of 1 (satisfactory) and a few of set 2 had ratings of 2 (slightly thin) at the start and end of their trial. Since these calves were not thin at the start, the gains did not result primarily from the fattening of the calves. Ten of the bulls of set 1 gained 2.75 pounds per day or more over the 154-day feeding period.

Correlations between age (A) and weight (B) at the start with gain (R) were 0.01 and -0.24 and with gain (H) were -0.10 and 0.12 and with gain (N) were -0.05 and -0.09, respectively, for set 1 calves. Analyses of variance, between and within bulls, indicated no statistically significant differences among the means of bull progeny groups for items B, N, and R of set 1 and H, O, and P of set 2. Significance at the five per cent level was found in age at the start (A), the means being 191, 222, and 242 days.

Animals from this herd have been sold to two stations within the S-10 project and to breeders in some Southern states.

IV. Plans for future work:

Continued cooperative work on feeding trials of calves seems forthcoming. It appears to be important to analyze carefully the data on groups of this size because they apparently present the kinds of problems which will be encountered in putting the results of research findings into use in Maryland (and perhaps other areas).

PROJECT C-14-a

I. Title: A STUDY OF THE PRODUCTIVENESS OF PUREBRED BEEF CATTLE IN MARYLAND

Subproject Title: EFFECT OF EARLY WEANING ON THE DURATION OF MATERNAL INFLUENCES IN BEEF CALVES

II. Objectives:

(1) To attempt to develop a new technic for an earlier evaluation of feed lot performance, progeny testing and genetic evaluation of beef animals.

(2) To develop sound feeding and management practices for early weaned beef calves.

(3) To evaluate the calves' genetic ability to thrive under new systems of care.

III. Accomplishments:

Since 1949, 81 calves have been fed individually from 90 to 370 days; and 66 calves, from 180 to 370 days of age. No more calves will be fed unless analysis of present data indicates a need for more data.

A. The main analysis completed to data (1949-1952 calves) was designed to estimate, by regression analysis, the amount of T.D.N. used for (a) growth and (b) non-growth (loosely, "maintenance") requirements. The primary results were: (a) that the estimated non-growth requirements in terms of a power of body weight was found to vary from 0.4 for the 90-202 day age period to 0.6 for the 90-370 day period, to 0.7 for the 202-370 day period; and (b) that the plotted results indicated some lack of reliability in making estimates for individual calves. This last may have resulted from the grouping of all calves into one set of data.

B. Except for a very few 1954 calves the growth curve for each calf has been plotted on regular and arith-log graph paper. Similar plotting has been done for 90 and 180 day weaned Aberdeen-Angus steers and heifers as four separate groups. By visual observations the regular graphs involving arithmetic spacings result in a rectilinear type of line in contrast to the curved line when arith-log paper is used. This, plus the fact that most gains during successive 28 day periods (based on group averages) fell within a range of 40-50 pounds, indicates that growth (or gain) may not be especially a function of body weight; i.e., heavier animals do not tend to gain more rapidly than lighter ones.

C. A number of analyses of variance have been completed through the 1953 data, testing for differences between year means and between means of sire progeny groups, preparatory to combining data for future analyses. Differences between the means of years and of bull progeny groups have, in the most part, been statistically non-significant.

D. With the exception of a few 1954 calves all Aberdeen-Angus calves have been listed in order, (a) within weaning age and sex and (b) total of all calves on the basis of weight, gain, etc., at different ages. A standard score has been calculated for some items. Average standard scores have not been computed to date.

E. Basic items, like sums, sums of squares, averages, etc., have been computed on a within years, sire, sex, and weaning age basis for all the calves. Further analysis of the data (other than the above) has not been done due to the priority of other work.

IV. Plans for the future:

For the reason just given, major analyses of the data are about to start. In general, the approach will be to limit the work to the data secured on the Aberdeen-Angus calves, (the number of Herefords being relatively small) and to make analyses on a within weaning age within sex within bull basis where correct to do so, and on a within year basis if analyses indicate that to be proper. As different bulls were used in different years, year and bull differences may be confounded in certain analyses. The following is comtemplated:

A. Regression coefficients based on a within weaning age, year, sire, and sex analysis will be calculated from data pertaining to each 28 day feeding period, starting at 90 days of age, in order to study the change in magnitude of the power of body weight associated with non-growth functions. Most workers have found the function of weight (W) to be $W^{.66}$ to $W^{.75}$. The $W^{.4}$ was quite different. If $W^{.xx}$ power changes when a finer analysis is made, age limits might be found below which it might not be wise to assay calves for efficiency of the use of T.D.N. for non-growth purposes if prediction is the main purpose of assay.

The amount of T.D.N. per unit gain is a widely used figure which, in the writer's opinion, does not, at times, give an accurate portrayal of the use of the feed. Most workers, of course, do make mental or other adjustments when using such figures. The results from analyses of a small amount of data have indicated differences between full sib and maternal half-sib groups in the amount of T.D.N. used for non-growth purposes, but not for growth purposes. The results of the intended analysis may suggest new kinds of research along the lines of developing new techniques for evaluating calves.

B. The predictability of rate of gain from one part of the calf's life to another will be studied by use of growth curves and factors affecting rate of gain. The reliability of estimates of the future performance of individual calves will be studied. Health and other records will be used in an attempt to discover reasons why some calves fluctuate more than others in the amount of gain from one 28 days period to another.

C. If the amount and type of data make it possible, heritability, economic, and other studies will be made to test the possible worth of weaning calves early (90 days) for the evaluation of their rate and economy of gain.

D. The use of standard scores will be explored to see if they have value in comparing calves or in selection indices.

PROJECT C-14-b

I. Title: TYPE CLASSIFICATION AS AN AID IN SELECTION OF BEEF BREEDING CATTLE

II. Objectives:

To determine the value of type classification in beef cattle, i.e., Heritability of Beef Type and Production.

III. Accomplishments:

Scores have been obtained on a number of herds since 1949 but from only one herd have the data been collected over a period of years (see Project C-14, III-A). Scores were secured on two sets of Aberdeen-Angus bull calves during the past year (see Project C-14, III-B). Since 1950, no analysis has been made of the data with the exception of the new herd added this year, table 1.

Analyses of variance based on between and within bull progeny groups indicated no statistically significant differences among the means of the over-all ratings of the bull progeny groups at either the start or end of the trial (see items C, D, E, K, L, and M, set 1, table 1) or among the over-all ratings at the June 8, 1955, scoring of set 2 calves. The differences between mean scores of progeny groups were highly significant for set 2 at the January 1955 scoring.

Intercorrelations among items C, D, and E for over-all rating were in the range of 0.63 to 0.72 and those among items C, D, and S for over-all ratings ranged from 0.77 to 0.85.

Somewhat detailed information is given in tables 1 and 2 because they seem to be of interest. In set 1, over a period of 154 days, scorer C, K reduced the average over-all ratings while scorer D, L and scorer E, M raised their averages. In set 2, over a period of 62 days, scorer C, K raised the average over-all rating while scorer D, L lowered the average slightly. In set 1 the correlations between score and weight at start (table 2) were very low, with one exception; yet for set 2, a number of the correlations are significant and negative, indicating a tendency to give heavier animals better ratings. Correlations between scores and the gain during the 102 day period for set 1 were quite low. Those between score and the gain during the 62 day period for set 2 were all positive indicating that those scored lower gained the best. This apparently did not result from thin animals receiving lower scores and then making higher gains by the addition of relatively more fat (see discussion under project C-14). Apparently some unconscious change in scoring took place. Changes of this nature could, of course, be of reasonably great economic value to a breeder.

IV. Plans are to continue this type of work for the same reasons as given under Project C-14, IV.

PROJECT C-14-d

I. Title: A STUDY OF THE PRODUCTIVENESS OF PUREBRED BEEF CATTLE IN MARYLAND

Subproject Title:

GROUP VERSUS INDIVIDUAL FEEDING OF WEANED BEEF CALVES

II. Objectives:

(1) To evaluate the accuracy of group vs. individually fed calves as a technique in the testing of sire-progeny groups.

(2) To study the possibility of forecasting the productiveness of beef calves by using single or combined measurements taken on live animals.

(3) To study the value of scores taken on live animals in relation to forecasting their performance.

(4) To compare measurements and scores in order to search for objective methods of determingin scores.

(5) To study absolute and relative changes in measurements and scores from one age to another.

III. Accomplishments:

This is a new project. The first calves go in trial in the fall of 1955.

IV. Plans for the future:

Approximately 24 calves of each breed of the University of Maryland's Aberdeen-Angus and Hereford herds will be available for each of two years. All calves will be weaned approximately on October 10, 1955, and 1956, and started on feed. One-half will be group fed and one-half will be individually fed for 224 days. Allotment of calves into feeding and management regimen will be made at random within breed and sex. Calves will be creep-fed while on pasture. Group-fed calves will be full-fed twice daily. Individually fed calves are to be fed the same ration, which is to be a good practical farmer's ration consisting of roughage, grain, and protein supplement. Minerals will be available constantly.

Records will be kept on all feed fed and consumed. Each calf will be weighed at birth, monthly intervals until weaning, at weaning, and each 28 days while on trial. Detailed scores and measurements will be made at weaning, 12 months of age, and at the end of the trial.

TABLE 1. MEANS AND STANDARD DEVIATIONS OF WEIGHTS, GAINS AND SCORES OF BULL CALVES

Item	Item Symbol	Mean[b]	Standard Deviation	Coefficient of Variation
	Set 1 calves[a]			%
(Oct. 28, 1954)	(X)			
Age	A	227	26.17	11.51
Weight	B	511	57.21	11.20
Over-all rating	C^1	2.51	0.35	13.86
Over-all rating	D	3.19	0.50	15.63
Over-all rating	E	2.67	0.25	9.30
(Jan. 28, 1955)	(Y)			
Age	O	319	26.17	8.19
Weight	P	745	56.62	7.60
Gain (X to Y)	R	234	25.36	10.84
Av. daily gain (X to Y)	T	2.54	0.28	10.83
(March 31, 1955)	(Z)			
Age	F	381	26.17	6.86
Weight	G	913	66.13	7.24
Gain (Y to Z)	H	169	20.93	12.42
Av. daily gain (Y to Z)	U	2.72	0.34	12.50
Gain (X to Z)	N	402	38.89	9.66
Av. daily gain (X to Z)	V	2.61	0.25	9.68
Over-all rating	K	2.72	0.38	14.06
Over-all rating	L	3.08	0.50	16.33
Over-all rating	M	2.45	0.39	16.01
	Set 2 calves[a]			
(Jan. 28, 1955)	(Y)			
Age	O	219	41.90	19.13
Weight	P	447	76.85	17.19
Over-all rating	C^2	2.76	0.27	9.90
Over-all rating	D	3.21	0.55	17.04
Over-all rating	S	2.98	0.47	15.92
(March 31, 1955)	(Z)			
Age	F	281	41.90	14.90
Weight	G	610	78.75	12.91
Gain (Y to Z)	H	163	18.93	11.61
Over-all score	K	2.63	0.21	8.11
Over-all score	L	3.28	0.49	15.01
Over-all score	M	2.43	0.30	12.38

[a]Number of calves in Set 1 = 27, in Set 2 = 25.

[b]Age is in terms of days. Weight and gain are given in pounds. Scores are on a scale wherein 1 is equal to an attainable ideal and 3 is equal to an "average" animal.

[1]Three men scored each animal at the start and end of the trial. Symbols C and K refer to the scores of one person, D and L to the second and E and M to the third person.

[2]See footnote No. 1. Scorer E of Set 1 did not score Set 2, Jan. 28. A fourth scorer was used (item S). Set 2 calves went on trial Jan. 28, 1955 and came off trial June 8, 1955. The March 31, 1955 scoring of Set 2 was an intermediate and not terminal scoring.

TABLE 2. CORRELATIONS BETWEEN CONFORMATION RATINGS AT START OF TRIALS AND WEIGHTS AND GAINS OF BEEF CALVES[1]

Item of Conformation	Scorer	Weight at start		Gain 1st period		Gain 154 days
		Set 1	Set 2	Set 1	Set 2	Set 1
		(B)	(P)	(R)	(H)	(N)
General Type	C	-.09	-.51**	-.04	.50*	-.02
	D	-.13	-.54**	-.01	.30	.11
	E	.29		-.15		.16
	S		-.43*		.34	
Head and neck	C	-.12	-.22	-.21	.31	-.11
	D	-.16	-.32	-.04	.26	.13
	E	-.31		.17		.34
	S		-.32		.24	
Fore quarter	C	.12	-.49*	-.12	.15	-.12
	D	-.07	-.32	-.03	.26	.05
	E	-.05		.18		.12
	S		-.23		.21	
Body	C	.00	-.46*	-.08	.07	-.04
	D	-.16	-.51**	.03	.37	.11
	E	.22		-.03		.09
	S		-.55**		.22	
Hind quarter	C	-.03	-.22	.01	.42*	-.06
	D	-.26	-.35	.17	.42*	.20
	E	-.01		-.04		.10
	S		-.20		.33	
Over-all rating	C	-.03	-.45*	.04	.42*	.02
	D	-.19	-.47*	.03	.33	.12
	E	.01		.19		.29
	S		-.75**		.28	

[1] Number of cases, Set 1, 28 and Set 2, 25.

* Statistically significant at the 5 per cent level.

**Statistically significant at the 1 per cent level.

North Carolina Report:

E. U. Dillard and J. H. Gregory

North Carolina has two principal projects which are a part of the regional beef cattle breeding project. The first of these projects has as its objectives the study of methods of measuring and evaluating performance in beef cattle. This has involved weighing, grading and measuring cattle at various ages as well as the use of post weaning rate of gain tests. Post weaning rate of gain tests have been carried out with bull and heifer calves since 1950. Bulls and heifers are group fed by sex groups. All except a few calves that were obviously inferior in 182 day grade and weight have been put on post weaning tests. A total of 47 Hereford, 14 Angus, 5 Shorthorn and 7 Romo-Sinuano heifers have completed these rate of gain tests. Gains have varied some from year to year but the difference between high and low individuals has remained about the same, approximately .80 pound per day. A total of 57 Hereford, 13 Angus, 5 Shorthorn, 13 Romo-Sinuano, 8 Brahman-Hereford and 9 Afrinander-Angus-Hereford bulls have been on post weaning rate of gain tests. Usually 8-12 Hereford bulls have been tested and the top four indexed on the basis of rate of gain and conformation score have been used in matings with 20-30 grade cows in herds at research stations.

Body measurements have been obtained on all purebred and Romo-Sinuano calves that were retained for test or herd replacement. Measurements have been obtained on approximately 200 head of cattle at 6 months of age, 135 cattle at 12 months of age and 60 head at two years of age. Parts of this data have been pooled with other data in the preparation of a regional publication.

Dr. W. C. Godley of Clemson, while a graduate student at North Carolina, did a research problem with data from the herds of the research stations on the heritabilities and genetic relationships among traits. He shall give you some of the results of that study.

The second of these projects was designed primarily to develop a breed or strain of beef cattle especially adapted to the Coastal Plain region of North Carolina and similar areas. This project was initiated in 1944 with matings of Brahman, Africander and Hereford bulls to grade Hereford cows. The small size of the herds maintained has severely limited progress in the formation of productive breeding groups derived from crossbred foundations. Comparative growth rates are determined for animals in each breeding group for use in evaluating these breeding groups. Items considered in selection are growth rate, conformation, vigor, temperament, etc.

These cattle are maintained at the Frying Pan Experimental Range under the rather rigorour conditions imposed by high humidity, hot temperatures, and often swampy conditions of the Tidewater area of this state.

The attached table gives a summary of the preweaning performance of the years 1952-1954 inclusive. Performance for 1955 would seem to be about the same as for the past two years on the basis of weights up to this time.

At the present time there are 34 Brahman crossbred cows and heifers of breeding age, 17 Africander crossbreds and 30 grade Hereford cows in the herd. In addition there are 4 Africander yearling heifers and 7 Brahman yearling heifers.

Inventory and Performance Data
Central Station - 1955

182 day weight - by breed and sex

	Hereford		Angus		Shorthorn		Romo-Sinuano		Grades	
	B	H	B	H	B	H	B	H	B	H
No. calves	18	13	4	4	3	3	2	5	7	10
182 day wt.	351	331	392.5	365	421	408	488	373.6	414	378.8
High weight	471	390	467	386	476	450	482	425	439	458
Lower weight	232	255	352	345	377	386	478	313	379	257
No. calves not weighed	0	0	0	1	1	0	0	0	0	2
Cows 2 yrs. & older	38		16		11		8		22	
Heifers under 2 yrs.	9		2				3		3	
Bulls over 1 yr.	10		2		1		2			
Total	88		29		19		20		44	

Low 182 day weight of calves probably due to low quality feed fed during calving and while calves were young (Dec., Jan., Feb.), and to younger cows.

FRYING PAN EXPERIMENTAL RANGE
Preweaning Performance of Calves in Breeding Groups

Sire	Dam	No. cows Calving	No. calves weaned	Av. birth date	Av. birth weight		Av. 6 mo. weight		Av. 6 mo. Type score		Av. weaning weight	
					B	H	B	H	B	H	B	H
1954												
H	GH	15	15	3-13-54	72	63	307	292	8.3	7.8	351	319
Br	GH	6	6	3-16-54	79	70	370	344	8.0	7.5	416	382
Br x	Br x	20	17	3-15-54	57	47	333	305	7.9	7.7	382	348
Af x	Af x	14	13	3-12-54	67	64	398	355	8.2	8.2	439	415
1953												
H	GH	16	15	3-2-53	64	63	307	273	8.7	7.7	340	304
Br	GH	6	6	3-8-53	54	65	370	327	7.0	6.6	385	339
Af x	Afx	6	6	3-15-53	67	60	406	338	7.3	7.7	432	340
1952												
H	GH	12	9	3-2-52	70	64	241	236	8.0	8.0	310	315
Br	GH	7	7	3-15-52	86	62	329	267	8.0	7.2	412	330
Br z	Br z	14	13	3-20-52	56	66	316	320	8.1	8.2	383	376
Af x	AF x	7	6	4-23-52	68	65	354	278	8.0	8.0	407	307

South Carolina Report

THE USE OF CROSSBRED DAMS FOR BEEF CALF PRODUCTION

E. G. Godbey and W. C. Godley

In the period from 1948 to 1953 a crossbreeding experiment was conducted with beef cattle at the Clemson College Coast Experiment Station and at the College Station. Brahman bulls were crossed on Angus and Hereford cows, Angus bulls were crossed on Hereford cows, and Hereford bulls were bred to Angus cows. Purebreds of the Angus and Hereford breeds were used. The calves were weighed at birth and weaning and animal grades were secured. Carcass grades and dressing percentages were taken on all of the bulls and part of the heifer calves.

These tests showed that the weaning weights of the calves produced by crossing the British breeds were the same as when Brahman bulls were crossed on the British cows. The crossbred calves were approximately 50 pounds heavier than the purebred calves at 210 days of age. These results indicated that it would be worthwhile to test the value of some of the crossbred heifers in the breeding herd. Heifers were kept out of the 1951, 1952, and 1953 calf crops. These crossbreds and the purebred Angus heifers were bred to a purebred Shorthorn bull to produce their first calves as three-year olds. The data in the following tables are related to these calves. Sixteen calves were produced in 1954 and 37 in 1955. Forty-seven cows have been bred for the 1956 calf crop.

TABLE I. BIRTH WEIGHTS OF CROSSBRED CALVES

Breed of Dam	Sire	No. of Calves	Birth Weight* Total	Birth Weight* Average	Weaning Weights* Total	Weaning Weights* Average	Weaning Weights* No. of Calves
BxH	S.H.	3	153	51	0	0	0
BxA	S.H.	17	1006	59.18	2306	461.20	5
HxA	S.H.	18	1222	66.08	2652	442.00	6
Total		38	2382	62.68	4958	450.73	11
A	S.H.	15	885	59.00	2026	405.20	5

TABLE II. DIFFERENCES BETWEEN WEIGHTS OF CALVES AND THEIR DAMS

Dams Breed	Dams No.	Dams Birth Wt.	Birth* Wt. Calves	Differences D - C	Differences Between 2nd and 1st calf Birth Weight	Differences Between Weaning Weight of Dams & 1st Calf
BH	3	69	59	10	- - - -	- - - -
BA	12	78	66	12	8 (5)	62 (5)
HA	12	72	63	9	6 (6)	103 (6)

*Weights used in these tables have been corrected for sex by subtracting four pounds from the birth weight and 37 pounds from the weaning weights of the bull calves. No corrections have been made for age of dam.

The number of calves that have been weighed at this time is not large enough to give much indication of what the final results will be. The differences in birth weights of calves of different breeding were not large. First and second calves are included in these from the Brahman x Angus and Hereford x Angus dams. The first calves from the Brahman x Hereford and the Angus heifers are included in this summary. The weaning weights of the Shorthorn x Angus were considerably lower than those from the crossbred heifers. Part of this difference is undoubtedly due to the age of the dams.

Table 2 shows how the weights of the calves compared with the weights of the dams taken at the same age. In our previous work Brahman x Angus and Hereford x Angus heifers had a weaning weight of 505 and 515 respectively.

Since we have just started weaning the 1955 calves none of them have been included in this summary. The five Brahman-Angus x Shorthorn calves produced in 1954 averaged 62 pounds less than their dams at the same age. The six Hereford-Angus x Shorthorn calves weighed 103 pounds less than their dams.

The present plan is to carry this work through 1958. A new Shorthorn bull will be used for the 1957 and 1958 calves.

Tennessee Station Report

Charles S. Hobbs and H. J. Smith

Beef cattle breeding research under the Southern Regional Beef Cattle Breeding Project (S-10) is being conducted at several locations within the state with herds at Knoxville, Alcoa (cooperative with Aluminum Company of America), Oak Ridge (University of Tennessee-Atomic Energy Commission), Greeneville, Crossville, Columbia, Springfield and Grand Junction (Ames Plantation). The breeding program with the Hereford and Angus herds at Knoxville includes a study of the effectiveness of selection based on type, performance and progeny testing in improving productivity. Hereford herds at Greeneville, Springfield and Columbia and the Angus herd at Crossville are being used primarily in a study and comparison of inbreeding, outbreeding and linecrossing. At Alcoa the herd is being used primarily for sire testing with emphasis on performance selection in herd improvement. The herd at Oak Ridge is being used in Hereford line evaluation studies and the progeny testing of sires. A Polled Hereford line is also being developed at this station. The Angus herd at Ames Plantation (added to the project in 1955) will be used in evaluation of Angus lines, sire testing and in studies on performance selection.

The objectives of the Tennessee project include: (1) The development of lines or line crosses, or combinations of lines and crosses, of beef cattle that will make the most efficient use of Tennessee pastures and forages and that will result in an improvement of such characters as rate of gain, economy of gain, carcass quality, fertility and longevity. (2) The development of effective breeding techniques for improving the productiveness of existing lines of beef cattle. (3) An investigation of productiveness of existing lines of beef cattle. (4) The effect of different levels of nutrition on the development of type, conformation, economy of gain, fertility and longevity.

Performance and Progeny Testing

During the fall and winter of 1954-55 the Tennessee station groupfed 24 Hereford and 10 Angus bulls under test conditions for 144 days on a high roughage ration. The bulls tested were selected from the calf crops of purebred herds at the main station and substations on the basis of a productivity index which gives equal importance to w eaning type grade and weaning weight at a standard age. The feeding test was conducted at the main station at Knoxville under drylot conditions. The bulls were sorted on the basis of weight and fed in groups of 11-12 in concrete lots with access to a barn. The rations fed consisted of concentrates (3 pounds per head daily), alfalfa hay (maximum of 4 pounds per head daily) and corn silage (ad libitum). At the end of the feeding test 16 Hereford and 5 Angus bulls were saved for progeny tests. They were selected on the basis of (1) weaning weight and type grade and (2) performance on post-weaning feeding tests. The average daily gain for the Hereford bulls on performance tests was 1.15 pounds (range, 0.66 - 1.42 pounds) and 1.22 pounds (range, 1.08 - 1.44 pounds) for the Angus bulls.

Progeny test data contributing information to the overall objectives and of specific value in selecting herd sires for the development of inbred lines and outbred herds were obtained on 3 Angus, 19 Hereford and 5 Polled Hereford bulls in 1954. Seven Angus and 29 Hereford bulls are being progeny tested in 1955. Differences in weaning weights and grades of calves by different bulls on a within year basis appear to be of sufficient magnitude to be of value in the selection of bulls for use in lines and herds. Analysis of data to estimate sire effects on weaning weights is planned.

Heifer calves at two stations were group-fed on performance tests for 140-150 days. The heifers were fed on winter pasture plus 3-5 pounds of concentrates and hay adlibitum. These performance tests with heifers are designed to provide performance information for selection of females to go into the breeding herds and to develop the heifers for use in the breeding herd as replacements. Future plans include similar performance tests of all heifers in the breeding program at all stations.

Level of Feeding Studies

The study of the effect of level of nutrition on the development of type, conformation, growth rate, economy of gain, and reproductive efficiency was continued during 1954-55. Trios of heifer calves are being fed on three different nutritional regimes: (1) nurse cow plus a full fed of concentrates and hay, (2) full feed of concentrates and hay and (3) customary practices for good commercial production (grass in summer - limited concentrates and hay during the winter up to 18 months). A summary of the growth data shows, in general, that differences in apparent type and weight between calves on various levels of feeding that are evident at 18 months of age have disappeared at 42-48 months of age (4 years).

Dwarfism Studies

The Tennessee Station Project, "The Detection of Animals Heterozygous for Recessive Bovine Dwarfism" was initiated with work in the spring of 1954 on about 65 calves in three progeny groups; two at the Greeneville station and one in the Alcoa herd. Each progeny group was sired by a bull known to carry the recessive gene for dwarfism. Since the dams of these calves must be nearly or completely free of this gene (no dwarf calves were produced), on the average about half of the calves should be carriers and about half noncarriers of the gene. X-ray pictures of the lumbar vertebrae of these calves taken at young ages (0-14 days) and classified according to techniques developed by Hazel and Emerson of Iowa State College are being studied along with other physical characteristics (measurements) in relation to genotype for dwarfism. Examination of the X-rays of these calves indicated a separtation into two approximately equal groups. Progeny tests are being conducted to determine whether these groupings are related to the presence of absence of the dwarf genes. During the 1955 breeding season, four presumed carrier and four presumed noncarrier bull calves selected from the three progeny groups were each mated to four known carrier cows to test the accuracy of the classification by the X-ray

technique. These cows will be kept until they calve to observe whether the progeny of these two X-ray types of bulls conform to expectation so far as the occurrence of dwarf calves is concerned. If the sires were separated correctly, the 16 calves from the four presumed carrier bulls should include around four dwarfs while calves sired by the other bulls should be normal.

All heifers X-rayed in the spring of 1954 were mated in the late spring of 1955 to dwarf bulls for further progeny tests of the X-ray techniques and to produce a number of known heterozygotes. This will permit a study of the kind and extent of vertebral abnormalities which are present in known heterozygotes.

A series of 32 measurements taken at 28 day intervals from birth to about weaning were made on the calves X-rayed in the spring of 1954. Body measurements were standardized to five months of age and summarized by X-ray classifications and sex. In general, measurements for the B type (carrier) calves were intermediate with respect to C type (noncarrier) and A type (dwarf) calves. Ratios of various body measurements were also intermediate in most cases. Average measurements from this summary indicated that the X-ray type carriers had slightly higher type scores and such desired characteristics as shorter heads, cannons and tibias than did the X-ray type noncarriers. The data suggest that a slightly higher percentage of X-ray type carriers would be favored in the selection of breeding stock. A discriminate function was applied to five body measurements including weight, loin width, head length, cannon length and body length. The differences between these functions for the noncarrier and carrier type classifications were significant in both sexes. The significances of these differences suggest a relationship between X-ray classification and the measurements included in the discriminate functions. With the exception of two calves, the separation of carrier from noncarrier females was identical with the separation given by X-ray classifications. However, there was considerable overlap between the measurement functions and the X-ray classifications of the male calves.

All purebred calves in the Angus and Hereford herds and some calves in the grade herds by bulls on progeny tests were X-rayed in the spring of 1955. Approximately 444 calves representing the progeny of 23 Hereford and 3 Angus bulls were X-rayed. Some of the bulls whose calves were X-rayed have proved to be carriers. If the cows in these herds are largely clean and it would appear that such is the case (a few dwarf calves have been produced), then it should be possible to evaluate the genotypes of the bulls with respect to the dwarfism gene on the basis of the X-ray classification of their progeny.

It is planned to continue the study of the X-ray technique for the identification of dwarf carriers with considerable emphasis on progeny tests to determine the accuracy of this method. Investigation of the X-ray technique applied to the cannon bone, tail and any other skeletal variations which appear to be promising in differentiating between carrier and noncarrier normal animals is also planned.

PUBLICATIONS

1. High, Joe W. Relationship of Body Measurements to Genotypes of Bovine Dwarfism as Estimated from X-ray of Lumbar Vertebrae. M. S. Thesis, University of Tennessee, August 1955.

2. Brown, Dougald E. Relationships Between Type Scores and Live Animal Measurements in Beef Cattle. M. S. Thesis. University of Tennessee June 1955.

3. Carrier, Joseph H. Effects of Different Levels of Feeding on Growth and Development in Beef Cattle. M. S. Thesis, University of Tennessee August 1955.

Texas Report

BLUEBONNET FARM REPORT

Project 650 and part of Project 607

- by -
T. C. Cartwright and B. L. Warwick

Bluebonnet Farm came into being when the Bluebonnet Ordinance Plant was turned over to the Texas A. & M. College System in 1948. This tract of land is approximately 17,500 acres and is located in a fertile area of Central Texas. The Air Force is in the process of repossessing about 11,000 acres of the original land and leaving the station about 6,500 acres. Negotiations are incomplete and the farm is still utilizing almost all of the farm land. The action of the Air Force has necessitated the removal of offices, feeding pens, and all other farm buildings to a new location on the farm. It has been necessary to fence and develop pastures in new areas and todevelop new water facilities. The moving and rebuilding has involved considerable time, trouble and expense, but by the end of the year we expect to be nearly back to normal.

Considerable work is yet to be done to complete the pasture fences and facilities. At present there are available 20 breeding pastures ranging from about 50 acres to about 300 acres. Some of these are shared by cattle, sheep and goats. There are five large fenced grazing areas that are usually planted in oats and available at certain seasons. Feed lot facilities and feed processing and feeding equipment are available for gain testing up to about 600 head. All of the feed for the livestock is grown on the farm.

The present inventory of cattle shows that there are about 485 breeding animals and replacement yearling heifers. The present calf crop numbers about 246 head. The breeds represented are the Hereford, Brahman, Santa Gertrudis, Charbray, Red Poll and nine types of crossbreds involving all breeds except the Charbray. Some of these cattle are on loan to the station. It is planned to reduce this number due to the activity of the Air Force. The number will be reduced this fall to about 350 mature animals. It is anticipated that this number will be increased gradually as pastures are improved.

The experimental work is divided into two projects. The first project is entitled "The improvement of production and adaptation of beef cattle within pure breeds and certain of their crosses through breeding methods." The objectives are:

1. The improvement of rate of gain by selection based on weaning weight and gain in the feed lot.
2. The improvement of rate of gain in the Brahman breed by crossing with the Hereford and backcrossing to the Brahman with recurrent selection.
3. To evaluate cattle with regard to adaptability to environment and to improve production during the hot months by selection based on individual summer gain.
4. To determine the magnitude of carcass differences within breeds and the heritability of such differences, to evaluate new crosses and breeds with respect to carcass merit, and to determine the relative potential value of the carcasses of bulls culled from the project.

5. To evaluate the significance of hybrid vigor in various crosses and their progeny with regard to gaining ability, carcass value, fertility and adaptability.

6. To cull from the herd animals with defects such as dwarfism.

7. To make available breeding animals of proven superiority in production.

The second project is entitled "Improvement of cattle through selection of performance-tested and progeny-tested sires." This is the gain test project started at Balmorhea in 1942 which has been extended to include Bluebonnet Farm and PanTech Farms. This includes only cooperator cattle. Last year 121 cattle belonging to cooperators were tested under this project at Bluebonnet. It is anticipated that in the next test the number will be about doubled. A group of interested breeders representing about 100 cattle that they desire to have gain tested at Bluebonnet contacted us and requested that later dates be set to allow testing of a large portion of their cattle. It is planned that two tests will be run, each partially overlapping the other and enabling calves born over a larger portion of the year to be tested. During the six years that the gain test has been in use at Bluebonnet Farm, 1669 calves have been tested. This includes both cooperator and Bluebonnet calves.

In general the cattle are managed in as practical manner as possible consistant with good experimental technique. It may be helpful to chronologically follow a calf through to maturity. The breeding season has extended from about April 10 for three months. The calves,therefore, are dropped from about the last of January until the last of April. At this a rather complete birth record is made for each calf. At about ten days of age the calf is castrated if it is scheduled to be and the birth information checked for errors. The calf is run with his mother until about 7 months of age but a 180 day adjusted weaning weight is obtained. All the calves are weighed when the oldest is 180 days of age and about every 28 days until the youngest is 180 days of age. At the actual weaning time the calf is dehorned if horned and the branding is completed. After a short holding period the calf is put on the regular 140 day gain evaluation test. This year the regular test starts November 15 after a two week adjustment period and ends April 17. The cooperator cattle are tested concurrently and are intermixed in the pens.

After the animal completes the gain test, he is turned out on pasture if he is a selected breeding animal. Low gainers, other culls and part of the steers are sent to market. All animals below average in gaining ability are sold for slaughter only. A sample of about 40 steers is sent to the meats laboratory at College Station. For one year and a part of another it was possible to keep the replacement individuals on shadeless pastures. A weight record taken about every 28 days is continued on the individuals through the summer and into the fall. If possible these weights are continued until the animal goes into the breeding pasture as a two.

During the two year period from birth, young individuals are culled at three principal times:

1. At weaning. All below average in adjusted weaning weight are culled. The culled calf may be sold while still carrying bloom or if feed is available he may be entered in the gain test and sold later. Culling at this time with this degree of intensity has been practiced only one year.

2. At the end of the gain test all below average of their sex group in pounds gain on the test are culled except for the Brahmans since they would have been eliminated. They are kept for their other desirable characters. Previous to the current year selections of females was less intense. With the reduction of the herd this season, females with gain records below the averages of their breed or cross and sex group were culled. Except for some of the Brahmans and some of the Red Polls the entire herd of Bluebonnet owned cattle now have gain test records that are average or above. The cull cattle are sold immediately after this test while their value is still high.

3. At the end of the summer after the gain test any individual far below the sex and breed average in pasture gain during the hottest summer months is culled. More study and data are necessary to warrant establishment of definite selection pressure for this character.

The most intense selection is on the young animal since this is more practical; however, cows may be culled because of low production records. If a cow misses calving one year she is culled unless she has a very good record otherwise. This culling is practiced several months after the last exposure to the bull which is during the fall to prevent wintering a "dry" cow. Cows and especially bulls are culled because of low progeny records. Animals are culled that have any defect or that have contracted any disease to which a predisposition is suspected of being hereditary, such as cancer eye and antinomycosis infections.

At the end of the gain test a number of steers and bulls are sent to the meats laboratory at A. & M. College where the animals are slaughtered and the carcasses are cut into standard cuts by Dr. O. D. Butler. The main purpose of this work is to determine carcass differences by progeny groups to establish a basis for selection on carcass quality. No consistant differences were found between sire progeny groups that would be of value in aiding selection. Sixty-four Hereford and 94 F_1 Hereford x Brahman crossbreds have been slaughtered. Few consistant important differences have been found between these two groups. The crossbreds have consistantly been about 2.7 points higher in dressing per cent. A close account has been made of the weight and fill of the GI tract which accounts for almost all of the difference in the dressing percent. The Herefords had more fill accounting for 2 points more total shring and the heavier tract for the remaining .7. Several other interesting aspects have developed from this study. Ine is the high repeatability of the standard cutting test as determined by cutting both sides of the carcass.

The carcass data are followed up in many instances by cooking tests in the Rural Home Research Laboratory under a project which is not a contributing project to S-10. Analysis and summarization of the carcass data in preparation for publication is nearly complete and this work should be in print within a year. Also included in this work is preparation of a station bulletin coordinating the production, carcass, and cooking or palatability phases of the research projects.

Preliminary observations indicate that the carcasses of bulls compare favorably with that of steers when the bulls are young (about 15 months). This seems to be true for juiceness, flavor and tenderness. At Bluebonnet, the bulls have gained an average of about 0.3 pounds more per day than the steers in the gain test and have weaned at about 25 to 30 pounds heavier weights.

A bulletin and a technical article have been published during the past year primarily concerning gaining ability. Copies of these have been distributed to all members of the S-10 technical committee. In general, high heritability estimates for rate of gain for young growing cattle in the feed lot have been found which range from 21 to 57%. Records of the progeny of selected high gaining bulls are beginning to become available in numbers that are large enough to offer convincing support to the estimates of heritability.

A technical article on the heat tolerance and adaptability studies at Bluebonnet Farm has been published recently and has been distributed to all the members of the Technical committee. Several differences in the degree of heat tolerance were found. The only significant difference between individuals within breeds was between gain in weight during the summer months while on pasture lacking shade. The heritability estimate of this character was found to be 19%.

Plans for the future include continuation of the present selection or breeding program with the possible addition of other breeds and their crosses. All of the cattle in the Bluebonnet herd with the exception of the Santa Gertrudis and some of the Brahmans and Red Polls have gain test records above average. No cattle are to be added to the herd unless they have acceptable gain records; that is, above average. A plan that has worked well in obtaining cattle on a loan basis, is to accept only young heifers or bulls that are of suitable age to be put in the gain test. If they fall below average they are returned to the owner who has gotten six months growth and some information on his calf. The calves that are above average are kept for a period of five years and all of their offspring are the property of the station.

Further analysis and summarization of data and reporting the results in bulletins and articles is anticipated. Included in this category is a study of the rates of growth at different periods (prenatal, pre-weaning and post-weaning) and the relationship between them. In this study a preliminary observation indicates that the age of dam does not effect the 180 day weight of calves which are from F_1 Hereford x Brahman dams to the same extent as it does the purebred Hereford calves.

Perhaps it is possible to select cows that have enough milk potential so that they produce all a young calf can take and level off about the same regardless of whether they are two's or three's, etc.

* * * *

Report of Project 607 at PanTech Farms
- by -
Frank H. Sims

At PanTech Farms five years of bull progeny tests have been concluded. Great variations between sire groups and between individuals have consistently been shown. Through five years, 543 young bulls, offspring of 84 herd sires have been tested for ability to gain on a growing ration. Ten percent of these bulls have gained over 400 pounds while fifteen percent have gained less than 300 pounds on 140 day feeding. The high gaining sire groups require considerably less feed per 100 pounds gained than the lower gaining sire groups.

One high gaining and one low gaining bull was purchased at the end of each of the first three years' tests to mate with random selected cow herds. Progeny of the high gaining sires averaged 38 pounds heavier at weaning time than the progeny of low gaining sires. The effect of high gaining sires on stocker heifers has also been demonstrated. At weaning time, heifers sired by high gaining sires were 41 pounds heavier than heifers by low gaining sires. The weight difference at 12 months was 60 pounds and at 18 months, 84 pounds, all in favor of progeny of high gaining sires. These heifers were summered on native grass and were wintered on cottonseed cake and native grass.

"High" and "low" steers have been fed three different years. Consistently the "high" steers have made approximately 36 pounds more gain on 140 day feeding of a growing ration. Feed required per 100 pound gain has been in favor of the high gaining steers, 73 pounds less required.

Following the feeding test, for the last three years, an auction sale has been held by the cooperating breeders. Sale order has been based on feedlot gain and conformation grade 50:50. It was definitely apparent at the sale this year that commercial cattlemen are beginning to demand high gaining sires. It is also apparent that these same cattlemen want a combination of gaining ability and high conformation grade.

Further study of gaining ability is being undertaken. A new project, "A Measure of Inherited Gaining Ability of Beef Cattle" has been set up to extend for a minimum duration of five years. Objectives of this project are:

1. To measure gaining ability of high and low gaining beef cattle.
2. To make a comparison, with regard to weaning weight and grade, stocker gain and grade, feedlot gain and grade, slaughter and carcass characteristics, and general marketability, of four beef cattle herds selected as follows:

   (1) "A" Herd: Selected for high gaining ability, and grade.
   (2) "B" Herd: Selected for high gaining ability.
   (3) "C" Herd: Control herd selected on conformation.
   (4) "F" Herd: Selected for low gaining ability.

For this project, 108 mature cows and 28 replacement heifers have been selected. Of these 108 cows, three years old or older, 107 have given birth to a calf during the 1955 calving season.

Report of Project 607 at Substation 9, Balmorhea, Texas
- by -
John H. Jones

The Balmorhea Station, J. J. Bayles, Superintendent, has fed young breeding cattle, bulls and heifers, the first winter after weaning for cooperators.

The object of this work was to aid in the selection of superior lines of cattle and to identify superior individuals within different lines. Heifers have been fed in addition to young bulls to enable the cooperators to start a herd of superior females. In most small 1 to 2 bull herds, developed after many years of selection, the females usually trace back to only a few of the original females.

The feeding of young stock the first winter after weaning speeds up development, and permits of their earlier use for breeding. Their potential for gain, fattening quality, body conformation and strength of feet and legs, constitutional ability to use feed and temperament are indicated.

The Station developed a method of feeding and economical rations suitable to the satisfactory development of the young breeding stock. The rations produce good rates of gain without excessive fattening. The rations are high in protein, and the mineral intake from the water and feeds grown in the area seems to be ample.

In the 1954-55 data, weight for age at both the outset and close of the test feeding period will be reviewed. Weight for age at the outset is drastically affected by a harsh preweaning environment. The data include a sample of such calves produced in San Augustine County. Apparently individuals from such environment may make high gains in the winter test feeding period, yet still show poorly on the basis of weight for age at the close of the test period. Of the limited population studied at Balmorhea, many of the cattle tended to follow the same pattern of weight increase per day of age as shown at the outset of the feeding period. Those making gains classified as high usually showed an increase in rate over and above that shown at the outset. The reverse held for those making gains classified as low. The increase or margin between weight for age, gain at the outset, and the rate on test feeding was most marked for the cattle from the poorer environments; yet some individuals from the harsh environment failed to respond satisfactorily to the test feeding. A digest of data through a period of years should indicate a rather close range of weights or of weight for age at which the calves should enter the test period within lines of breeding. Apparently the lines of cattle modified through breeding selection to rather extreme shortness and thickness consistently fail to make high gains in the test period, although they may show fair values in weight for age at the outset of the test feeding period.

Contributing Project 714

METHODS FOR MEASURING POTENTIAL RATE OF GAIN AND EFFICIENCY OF FEED UTILIZATION IN IMMATURE BEEF CATTLE

- by -
H. O. Kunkel, D. K. Stokes, Jr., E. C. Stutts and J. L. Fletcher

The principal approach in this program of investigation has been the search for a biochemical method of measuring the potential rate of gain in immature beef cattle. Since blood is the easiest tissue to remove from the body without great injury to the animal, the chemical composition of this tissue has received the greatest attention.

The first indication of a relationship between the level of a blood component to the rate of gain was obtained when significant negative correlations were obtained between the serum protein-bound iodine (PBI) value and the rate of gain and efficiency of feed utilization in a group of ten Hereford bulls (Jour. Animal Sci., 12:3, 1953). Studies with other small groups of animals suggested a curvilinear relationship between the PBI (as indicative of thyroid activity) and rate of gain suggestion that an optimum level of PBI was commensurate with maximum gain.

Since the time of this first indication that a biochemical index of potential rate of gain and efficiency of feed utilization was feasible, work has been continued and expanded with major consideration of the relationship rate of gain to the pretest level of serum protein-bound iodine, serum alkaline phosphatase, and blood reduced glutathione.

Serum Protein-Bound Iodine

The greatest difficulty encountered in the investigation of the PBI level in the blood serum of young beef cattle was the lack of a laboratory method for the determination of the PBI which would give consistent and reproducible values.

All available methods for the determination of iodine in quantities as minute as occurring in the protein-bound iodine of blood serum involves the detection of iodine as a catalyst in the reduction of ceric ions by arsenious acid. Thus, the iodine is not measured directly but is estimated by the extent it speeds up an unrelated chemical reaction. It is also a reaction which may be accelerated or inhibited by otherwise undetectable contaminants in the system. As a result, the repeatabilities of the method have ranged only between 0.54 and 0.85. Much time has been spent in efforts to develop more reliable methods without any great degree of success.

The method for the PBI determination used for this study is essentially that described by Brown, Reingold, and Sampson (Jour. Clin. Endocrin., 13:444, 1953) using an internal standard. Using this method, analyzing each serum sample in triplicate and considering the average values obtained in the determinations of each sample, statistically significant correlations were obtained between values from samples collected at four to five month intervals in cattle in record

of performance tests (table 1). Although the repeatabilities are not as great as might be hoped for, they are of a magnitude which demonstrates relatively permanent differences in the serum PBI level.

The results of attempts over a period of four years to correlate the PBI levels with the rates of gain in record of performance tests are summarized in Table 2. Included are the calculated correlations of data reported in published form (Jour. Animal Sci., 12:3, 1953).

It may be seen that the attempts to detect either a simple linear or a curvilinear relationship have not been uniformly successful. However, in addition to 1952 group of bulls described above, two other groups of data, from a group of heifers and from a group of steers, showed statistically significant curvilinear correlations suggesting that in these groups an optimum level of PBI was related with maximum gain.

The serum PBI levels of bovine dwarfs and of comprest types of calves are not significantly different from the levels found in conventional types of calves. It is therefore evident that if the PBI level is indicative of thyroid activity, altered thyroid activity is not responsible for the reduced growth rate of dwarfs and comprest calves, evidence also that factors other than the protein-bound iodine is related to rate of growth or of feed-lot fattening.

It is evident that if the serum PBI level is related in a broad sense to growth rate, it does not have in itself a high predictive value. Yet it is to be noted that in only three of the groups of calves considered the coefficient of variation of the PBI level is above 20% and two of these three groups show the significant curvilinear correlations. This fact suggests that in groups wherever variation in PBI is very great, a relation to subsequent rate of gain is likely and should be considered along with the factors in developing a predictive index in spite of the inadequacies of the laboratory method of determination of PBI. As an example of such consideration, the curvilinear correlation between PBI and gain for the twenty-eight Brahman heifers of group designated 1954-55 in Table 2 is 0.426, a non-significant value. With these heifers, it was found that the correlation between the pretest gain (calculated by taking initial test weight, subtracting 65 pounds for an assumed birth weight, and dividing by the age in days) was 0.436, a value significant at the 0.05 level. Combining in multiple correlation the curvilinear correlation of PBI and the simple correlation of the pretest gain yields a value for R of 0.664, a correlation of a significance at the 0.01 level of probability and accounting for an appreciable amount of the variation in gain. Thus the assessment of the value of PBI in the prediction of gain in immature beef cattle must be held in abeyance until other factors related to gain can be evaluated more thoroughly. It is with this point in mind that future investigations of PBI and the statistical analyses of the results of investigations are planned.

Serum Alkaline Phosphatase in Brahman Cattle

The average serum alkaline phosphatase of cattle of the Brahman breed is approximately twice that of the European breeds (Kunkel, Stokes, Anthony, and Futrell, Jour. Animal Sci., 12:765, 1953). In preliminary studies, the correlation between subsequent determinations of phosphatase on the same animals of

European breeds was relatively low, but the correlation was of statistical significance in the Brahman breed. In addition, early results indicated a possible relationship between the phosphatase and subsequent gain. These points were of sufficient interest to warrant an extended investigation of the relationship of the serum alkaline phosphatase activity and rate of gain in Brahman cattle.

Data are now available from three years work on the relationship of phosphatase and subsequent gain. Five groups of bulls and five groups of heifers have been involved. In each of the three years one group of heifers and one group of bulls were in the record of performance tests at Bluebonnet Farm. A group of 15 heifers and a group of 27 bulls 7-10 months of age were located at the Vernon Frost Ranch, Simonton, Texas, and were maintained under ranch conditions with some supplemental feeding. Ranch conditions with supplemental feeding were also represented in its treatment of two groups, male and female, of suckling calves located at the J. D. Hudgins Ranch, Hungerford, Texas.

The data are summarized in Table 3. The correlations between the serum alkaline phosphatase and subsequent gain are quite varied ranging from the extremes of 0.626 for a group of Bluebonnet bulls in 1953 to -0.346 for the 1954 Bluebonnet bulls. However, it should be noted that the only statistically significant correlations between phosphatase and gain are positive. These were obtained in the larger groups which might well be considered more adequate and reliable groups.

As data on age and weight at the beginning of the test were available and since the phosphatase is negatively related to age and weight, multiple correlations involving these variables were calculated. Four of the eight multiple correlations were statistically significant and two others approached significance. In all cases the multiple correlations represented substantial increases in the variation attributable to the regression over that of the simple correlation.

The variability of results suggests the need for certain additional investigation. A basic study of the effect of variations in the field conditions under which blood samples are secured would seem desirable in view of some instability in the serum phosphatase. In addition, efforts will be made to secure data from more adequately sized groups of animals maintained under similar conditions at a common location.

Blood Glutathione

The level of blood glutathione (GSH) in young beef cattle appears to be a characteristic of the animal and it is a highly repeatable measurement (Kunkel, Stutts, and Shrode, Jour. Animal Sci., 13:852, 1954). The glutathione in the blood is found almost exclusively in the erythrocyte and it would be expected that the glutathione to hemoglobin ratio (GSH/Hb) to be an even more highly repeatable measurement. Experimentally, this has been found to be true. For example, the correlation between determinations of GSH in samples from a group of Brahman bulls at the beginning and at the end of a 140-day feeding trial was 0.672, a statistically highly significant correlation; however, the repeatability of the GSH/Hb ratio for these same animals was a much higher 0.845. Similar results have been noted in all groups tested.

When the GSH level or the GSH/Hb ratio was extremely high in the Brahman and in the Angus, gain was poor. However, where observations have been made in sufficient numbers to permit statistical analyses, the product-moment correlations were small and not significant statistically. Examples of such data are given in Table 4.

It was noted, however, in the process of testing certain relationships in a group of 30 Brahman heifers where both GSH and PBI values were available, the GSH to PBI ratio was significantly correlated with subsequent gain in a curvilinear manner ($R = 0.555$, $p < 0.01$). This suggested a possible multiple regression of gain on GSH and PBI and therefore the data collected earlier were reevaluated and further blood samples were collected and analyzed in an attempt to detect any curvilinear relationships of the more highly repeatable BSH/Hb ratio to gain. The results of the calculations made thus far are given in Table 4.

The curvilinear correlations of the four groups of Brahman and the Charbray are of sufficient magnitude to be of interest. Statistical significance ($p < 0.05$) was evident in the cases of the larger group of Brahman heifers and of the Charbray heifers. However, the correlation with the Herefords is small and insignificant.

The GSH concentration in the Hereford cattle on test has been found to be established not only by heredity, but the GSH concentration (GSH/Hb ratio) bears small but positive relationships to age, body weight, and the pretest gain. At present, these relationships have not been clearly evaluated, but the evidence at hand indicates although the GSH/Hb may be affected by pretest environmental factors, it is relatively constant during the feeding test period. If this is true, this fact alone would justify further study of the GSH level for it may provide a means of evaluating the pretest conditions which affect record of performance testing.

Plans for Future Research

The recurrence of statistically significant correlations between the investigated blood constituents and gain is strong evidence that the relationship between certain blood components can be eventually used to form the basis of a predictive index to subsequent gaining ability in cattle. On the other hand, the recurrence of small and insignificant correlations suggests extreme caution in extrapolating the information obtained under one set of conditions to another.

Our present line of thinking in planning future research is that the problem is two-fold:

1. There is a fundamental necessity of developing standardized methods of laboratory analyses wherein values taken at various times during the year can be compared from an absolute as well as the relative standpoint on which comparisons have been made thus far. This involves not only laboratory technique but evaluation of environmental effects on experimental animals.

2. Secondly, it appears that any predictive which may be developed will consider a number of factors. Therefore in addition to the PBI, phosphatase, GSH and hemoglobin, work is planned to include during the coming year, analyses on serum cholesterol and free non-essential amino acid concentration in the plasma.

Multiple regressions will be calculated, and each contributing factor will be evaluated on the extent of its contribution as indicated by the partial regression coefficient.

At the present time, there is still further opportunity to evaluate statistically the data already collected. Time has been the limiting factor in a complete study so far.

It is hoped that a test group of animals can again be assembled at College Station to provide opportunity for a closer study of environmental factors and of the relationship of the blood constituents to the efficiency of feed utilization. Negotiations for such a group is under way at the present time.

The use of the experimental animals in record of performance tests will be continued.

Table 1. Repeatability of Determinations of Protein-Bound Iodine Levels in Feed-Lot Cattle

Group Designation	Number	Dates of Sampling	r
Hereford & Angus Steers	14	9/1/53 2/12/54	0.615*
Hereford & Angus Heifers	16	9/1/53 2/12/54	0.503*
Hereford & Angus Bulls and Heifers	50	12/10/54 4/29/55	0.509**
Brahman Bulls and Heifers	29	12/22/54 4/29/55	0.398*

* Significant at the 0.05 level of probability

**Significant at the 0.01 level of probability

Table 2. Product-Moment and Curvilinear Correlations between the Serum Protein-Bound Iodine Level and Rate of Gain in Herefords and Angus

Year & Group	Sex	Number H[1]	Number A[1]	Number B[1]	Coefficient of Variation of PBI	Correlations: Product-Moment	Correlations: Curvilinear
					%		
1952 - 1	Bulls	11	12		21.9	-0.140	0.684**
1953 - 1	Bulls	11	9		13.4	0.130	0.231
- 2		44	4		18.5	-0.058	0.213
- 3	Heifers	11	7		29.9	-0.420	0.627*
- 4		20			15.2	0.410	0.460
- 5	Steers	33			16.8	0.122	0.135
- 6		10	12		16.2	-0.228	0.322
1954 - 1	Bulls	12			14.5	-0.088	0.088
- 2	Heifers	11	10		11.6	0.238	0.318
- 3		18			8.4	-0.088	0.209
- 4		36			12.1	-0.022	0.072
- 5				28	11.7	-0.246	0.426
- 6	Steers	7	7		13.0	0.211	0.684*
- 7		15			24.0	0.237	0.260
1955 - 1	Bulls	78	6		13.1	-0.209	0.214
- 2		12	3		10.1	-0.003	0.338
- 3	Heifers	31	3		14.6	-0.033	0.12[illegible]

* Significant at 5% level of probability

**Significant at 1% level of probability

[1] Symbols: H = Hereford, A = Angus, B = Brahman

Table 3. Phosphatase, Age, Weight, and Gain in Brahman Cattle

Group, Location and year	Sex	No.	Av. Initial Age	Av. Initial Weight	Av. Phospha-tase	Av. Gain	Product - Moment			Multiple	
							r_{pg}	r_{ag}	r_{wg}	$R_{g.aw}$	$R_{g.awp}$
			days	lbs.	units	lbs.					
BF '53	M	24	273	516	6.97	242	0.626**	0.191	-0.053	0.208	0.704**
BF '53	F	15	281	441	8.16	185	-0.024	0.156	0.289	0.300	0.333
BF '54	M	15	260	505	6.38	264	-0.346	0.090	0.334	0.343	0.613
BF '54	F	38	262	455	6.01	194	0.447**	-0.414**	0.460**	0.525**	0.794**
BF '55	M	14	260	440	4.43	287	0.071	-0.025	-0.181	0.241	0.247
BF '55	F	15	282	425	4.31	215	0.429	0.192	0.182	0.232	0.657
Frost '55	M	27	246	- -	4.33	668[2]	0.415*[3]				
Frost '55	F	15	288	- -	5.64	574[2]	0.425[3]				
Hudgins '55	M	15	90	283	13.07	277	-0.267	0.021	0.615*	0.738**	0.747**
Hudgins '55	F	14	84	244	15.97	235	0.352	-0.141	0.083	0.838**	0.853**

[1]Symbols:
p = phosphatase
g = gain
w = weight
a = age

[2]Weights adjusted to 376 days for bulls and 412 for heifers

[3]Correlation between weights adjusted for age and phosphatase adjusted for initial age.

Table 4. Correlations between the Glutathione-Hemoglobin Ratio and Rate of Gain

Year	Breed	Sex	Number	Correlations	
				Product-Moment	Curvilinear
1954	Brahman	Heifers	36	-0.001	0.409*
		Bulls	15	-0.398	0.507
1955	Brahman	Heifers	14	-0.149	0.489
		Bulls	14	0.500	0.500
	Charbray	Heifers	28	0.149	0.527*
	Hereford	Bulls	67	-0.033	0.178

*Significant at 0.05 level of probability

Texas

Contributing Project 959

Biochemical and Physiological Anomalies of Bovine Dwarfism and Their Use in Detection of Heterozygotes

H. O. Kunkel

The serum protein-bound iodine, the reduced glutathione of blood and the serum alkaline phosphatase levels have been investigated in bovine dwarfs of the Hereford and Angus breeds. The average phosphatase appears to be lower than, the glutathione level greater than, and the protein-bound iodine level no different from the respective levels of so called normal animals. The phosphatase and glutathione levels do not appear to be of diagnostic value because the differences are not very great.

Since the connective tissues are the tissues which appear to undergo the greatest change from a gross inspection, the present emphasis is on a chemical and histological study of these tissues. Skin and cartilage are being studied to the greatest degree. At the present time, not enough normal animals have been included to determine the extent or significance of the differences which may exist. Maximum effort is now being put into this project.

Virginia Report

DEVELOPMENT OF FOUNDATION HERDS AT THE BEEF CATTLE RESEARCH STATION, FRONT ROYAL, VIRGINIA

Long term breeding plans for this station envisage comparison of the performance on inbred lines and crosses among inbred lines with mass selection within three beef breeds - Angus, Hereford, and Shorthorn.

Foundation females in each system will be random samples of equal numbers from proven foundation sires. Each foundation sire will contribute 32 daughters, of which 16 will go into a closed line, 8 into a breed selected for growth rate and 8 into a herd selected for type. Two foundation sets (32 head in each) were available from previous work by the U. S. D. A. at Beltsville when the station was started in 1949. It is planned to have in all four or five foundation sets, each of Shorthorns and Angus breeds and six or seven in the Hereford breed. Progress to date has been as follows:

Shorthorn - In addition to the two foundation groups of Shorthorns already in selection herds sufficient females were produced in 1955 to complete a third foundation group of 32 female offspring of another bull. This bull, Grassdale Leader, was bred back to some of the oldest of his daughters this year and other daughters went into growth and type selection herds. Two Shorthorn bulls, Prince Eric 2655-343 and Britomac Prince Command 2686-140 were bred to cows to produce foundation sets of 32 females each. This will complete the requirements for foundation females in the Shorthorn breed.

Angus - The Eilleenmere foundation herd had 32 daughters of K. B. Eillenmere 21st, 1103554, of breeding age and these females were randomized to an inbred herd, to the growth herd and to the type herd. Sufficient females were produced in 1955 to complete a second foundation group of 32 female offspring of another bull. This bull, Rock Delus, 1404534, was not used in the 1955 breeding season since not enough of his daughters were of breeding age.

Hereford - Only one Hereford bull had sufficient daughters to form a foundation line of 32 females; however, this bull produced dwarf calves when mated to his daughters. One Hereford bull, C. M. F. Royal Domino was bred to a number of cows for the purpose of producing foundation females. Four other Hereford bulls were bred in test herds for the purpose of determining their value as sires of foundation herds. One of these bulls was from the Miles City #1 line and one was from the Georgia Polled line.

MATINGS AMONG DIFFERENT TYPES OF CARRIERS OF DWARFISM AT FRONT ROYAL

Three types of matings were made in 1954 to obtain genetic information on dwarfism in Herefords and Angus.

The numbers and performance of dwarf and normal calves obtained in 1955 from these matings were as follows:

Sex of Calves	Kind of Calves	Weight at birth No.	Weight at birth Average	Weight at 120 days No.	Weight at 120 days Average
I. Suspected carrier bull mated to 22 daughters (a son of this had sired a dwarf calf when mated to comprest heifers).					
Male (1)	Normal	9	61	9	221
	Dwarf	1	49	1	163
Female	Normal	9	59	9	222
	Dwarf	2	40	2	143
II. Carrier Angus bull mated to daughters of a conventional carrier Hereford bull.					
Male	Normal	2	70	2	302
	Dwarf	1	57	1	199
Female	Normal	3	62	3	268
	Dwarf	2	66 (1 dead)	1	235
III. Carrier Angus bull (same as II) mated to comprest cows.					
Male	Normal	3	76	2	320
	Dwarf	1	63 (died)		

(1) One male calf weighing 48 pounds and dead at birth was not diagnosed with respect to dwarfism or normality.

Summary - These data suggest that the same loci may be involved in dwarfism in conventional Herefords, comprest Herefords and at least one kind of dwarfism in Angus.

ESTIMATING BIRTH WEIGHT OF CALVES FROM CHEST CIRCUMFERENCE

C. M. Kincaid

The regression of birth weight on chest circumference was studied by computing coefficients (weight in pounds/chest circumference in inches) within year, breed and sex of 1034 calves born at Front Royal from 1950 to 1954 inclusive.

The coefficients for each group are shown in table I. When the birth weights of all calves ignoring year, breed and sex were plotted against chest circumference the trend appeared to be essentially linear over the entire range (birth weight from 35 to 98 pounds and chest circumference from 22 to 32 inches. The analysis of variance of the regression coefficients by groups (table II) indicated that one regression equation would give a fairly satisfactory approximation of birth weight as observed chest circumference was known. The standard deviation of birth weight as observed was 8.75 pounds and 4.10 pounds when adjusted for regression on chest circumference. The equation for estimating birth weight from chest circumference was:

$$BW = 65 - 5.67\,(c-27)$$

$$= \frac{17c - 264}{3}$$

Where BW was estimated birth weight in pounds, c was the chest circumference in inches.

Table I - Regression of weight (pounds) on chest circumference (inches) by year-breed-sex groups of calves born at Front Royal

Breed	Sex	Year 1950	1951	1952	1953	1954	Average
Angus	Male	4.95	4.17	5.91	5.28	6.90	5.50
	Female	4.36	3.73	5.69	5.26	5.89	4.99
Hereford	Male	4.61	6.33	5.91	7.17	5.85	5.97
	Female	5.76	5.65	5.34	6.60	6.56	5.98
Short-horn	Male	6.86	5.29	6.01	6.86	5.26	6.06
	Female	5.63	3.94	6.25	5.39	6.28	5.50
Average	Male	5.47	4.63	5.94	5.63	6.00	5.84
	Female	5.25	4.44	5.76	5.75	6.24	5.49
	Year	5.36	4.54	5.85	5.69	6.12	5.67

Table II - Analysis of variance of regression coefficients in table I.

Source of Variation	Df.	Mean Square
Year	4	1.84
Breed	2	1.44
Sex	1	.95
Breed X Year	8	.86
Residual	14	.33

PERMANENCY OF CONFORMATION SCORES PLACED ON BEEF HEIFERS

Martin J. Burris and B. M. Priode

Conformation scores were placed on 29 Shorthorn, 38 Hereford and 35 Angus heifers by five judges all scoring independently. Scoring was done at three different times, July 1954, September 1954 and March 1955. Three of the five judges scored all heifers each time. The respective average ages of the calves at scoring were 5, 7½ and 13 months.

The analysis of variance, components of variance, correlation within judge for scores of the same calf at different times and correlation among judges scoring at the same time are shown in tables I, II, and III. The data indicate that the conformation score placed on a calf at 4 or 5 months of age is a fairly permanent characteristic, but individual calves may change considerably between scoring intervals.

Table I - Analysis of variance of scores placed on heifer calves

Source of Variation	D.F.	Mean Square	F.	Component of Variance Size	Component of Variance Proportion of Total
Shorthorn Heifers					
Judges	2	13.73	3.41	.111	.036
Times	2	9.91	2.46	.036	.012
Calves	28	12.91	3.97**	.948	.313
J X T	4	4.03	7.62**	.121	.040
J X C	56	1.65	3.13**	.375	.124
T X C	56	3.25	6.15**	.908	.300
T X C X J	112	.53		.529	.175
Angus Heifers					
Judges	2	34.40	48.32**	.314	.075
Times	2	40.31	22.49**	.362	.087
Calves	34	23.05	12.86**	2.337	.560
J X T	4	1.19	1.66	.013	.003
J X C	68	.94	1.32	.075	.018
T X C	68	1.79	2.52**	.360	.086
T X C X J	136	.71		.712	.171
Hereford Heifers					
Judges	2	14.78	7.33*	.109	.045
Times	2	4.86	2.35	.012	.005
Calves	37	11.80	5.71**	1.047	.432
J X T	4	2.02	3.20*	.040	.017
J X C	74	.94	1.50*	.104	.043
T X C	74	2.07	3.28**	.479	.198
T X C X J	148	.63		.630	.260

Repeatability of conformation scores on beef heifers by a panel of judges.

Breed	Repeatability
Shorthorn	.343
Angus	.671
Hereford	.463

Table Ia - Theoretical composition of the mean squares of the analysis of variance used in this paper.

Source of Variation	Components of Variance of Mean Squares
Judges	E - NcJT - Nt. JC - Nt.Nc.J
Times	E - Nc.JT - Nj.TC - Nj.Nc.T
Calves	E - NT.JC - Nj.TC - Nt.Nj.C
Judges x Times	E - NcJT
Judges x Calves	E - Nt.JC
Times X Calves	E - Nj.TC
Judges x Times X Calves	E

Key to Symbols Used Above

J Variance due to differences between judges.

T Variance due to differences between times.

C Variance due to differences between calves.

JT Variance due to the interaction between judges and times.

JC Variance due to the interaction between judges and calves.

TC Variance due to the interaction between times and calves.

E Variance not accounted for by the above factors.

Nj Number of judges (3).

Nt Number of times scored (3).

Nc Number of calves (29, 35, or 38).

Table II - Zero order correlation between scores of calves by the same judges at different times.

Breed	Judge	TIME 1 X 2	1 X 3	2 X 3
Shorthorn	K	.601	.310	.422
	W	.647	.380	.543
	P	.713	.324	.489
Angus	K	.834	.692	.718
	W	.664	.595	.725
	P	.634	.679	.702
Hereford	K	.7001	.586	.497
	W	.7224	.479	.605
	P	.5687	.311	.308

Table III - Zero order correlations between scores of calves by different judges scoring on the same day.

Breed	Date	K X W	K X P	W X P
Shorthorn	(1) July, 1954	.740	.709	.742
	(2) Sept., 1954	.658	.562	.759
	(3) Mar., 1955	.806	.768	.751
Angus	(1) July, 1954	.830	.759	.717
	(2) Sept., 1954	.822	.756	.756
	(3) Mar., 1955	.839	.811	.785
Hereford	(1) July, 1954	.793	.655	.616
	(2) Sept.,1954	.787	.793	.645
	(3) Mar., 1955	.591	.754	.633

INDIVIDUAL VERSUS GROUP FEEDING OF STEERS ON FULL FEED

C. M. Kincaid, J. S. Copenhaver and
F. S. McClaugherty

To compare individual and group feed for R.O.P. steers, three steers were selected at random from 8 different sire progenies and fed individually for 112 days. The remainder of the steers in each sire progeny were fed in two groups. In all there were 24 steers on individual feeding and 39 on group feeding.

A surplus of feed was kept before all animals at all times. The ration was 25% ground hay, 65% ground ear corn and 10% oil meal mixed and fed as one feed. All steers were treated alike with respect to feed, water and exercise. They were in the barn at all times with feed before them except for two periods of about one hour each starting at 8:00 a.m. and 4:00 p.m.

The calves were weaned October 14, 1952 and fed in two groups to December 30 (77 days). The experimental phase started December 30, 1952 and ended April 21, 1953 (112 days).

Average differences within sire progenies (table I) for gain, feed intake carcass grade and yield were small and appear to be due largely to random sampling errors.

To study variation in rate of gain a regression coefficient (weight/14-day period) was computed for each steer. The average of these coefficients within sire and feeding and average daily gain from them by sire and feeding method is shown in table II. The analysis of variance of coefficients within sires and feeding methods (table III) shows larger variances both within and among sires for those fed in groups. This suggests that "peck order" or similar heritable social factors had an opportunity to operate in groups and not with individual feeding. Perhaps individual feeding is most useful for measuring efficiency when the animal is free of competitive pressures, while group feeding measures ability to perform as a member of a group where there is at least some social pressure.

The analysis of variance of regression of weights on a 14-day period (table IV) indicates that differences between fast and slow gaining sires within pairs was the only important source of variation.

It is suggested that a combination of individual and group feeding for each sire progeny may be a more precise means of proving sires. This could be accomplished by (1) individual feeding for the whole test period a sample of progeny and group feeding the remainder, or (2) individual feeding in one part of the test period and group feeding in another, or (3) group feeding all steers with samples from each progeny on individual feeding for short periods during the test so that all or part of each progeny would have records of individual feed intake part of the time.

Table I - Averages and differences within sires for two methods of self-feeding steers 114 days on a mixed ration.

	Feeding Method I Individual Feeding	Feeding Method II Group Feeding	Average Differences I - II
Number of Steers	24	39	
Average Initial Weight (lbs.)	550	548	2 ± 9
Average final Weight (lbs.)	759	760	-1 ± 13
Average Gain per Steer (lbs.)	209	212	-3 ± 12
Average Feed Intake per day (lbs.)	17.90	17.72	0.18 ± .16
Average Carcass Grade	11.51	11.80	-.29 ± .17
Average Dressing Percentage	56.3	56.7	-0.4 ± 0.5

Standard error differences were obtained from paired mean differences within 8 sires. Numerical values of grades were 7, 10, and 13 for commercial, good, and choice, respectively. Dressing percentage based on final live weight at home and hot carcass weight.

Table II - Mean regression of weight on 14-day periods and average daily gain by sire and method of feeding.

Sire	Feeding Method Individual	Feeding Method Group	Sire Averages 14-Day	Sire Averages Daily
A11	28.83	30.89	29.86	2.13
A12	29.52	26.86	28.19	2.01
H11	31.25	32.14	31.70	2.26
H12	27.52	28.93	28.22	2.02
H21	31.00	30.83	30.92	2.21
H22	32.13	29.23	30.68	2.19
S11	29.60	33.06	31.33	2.24
S12	27.20	30.14	28.67	2.05
Averages 14-day	29.63	30.26	29.95	
Daily	2.12	2.16	2.14	

Table III - Analysis of variance of individual regression coefficients (weight/14-day periods) within sire and method of feeding.

Source of Variation	Method of Feeding: Individual Df.	Individual M.S.	Group Df.	Group M.S.
Sires	7	9.31	7	17.93
Within sires	16	7.87	31	11.60

Table IV - Analysis of Variance of data in table II.

Source of Variation	Df.	M.S.
Fast vs. slow sires	1	16.14
Feeding method	1	1.58
Residual	13	2.47
Within sire & individual feeding	16	2.63
group feeding	31	2.38

PERFORMANCE TESTING: A NEW TOOL FOR VIRGINIA'S BEEF CATTLE BREEDERS

T. J. Marlowe, C. M. Kincaid and C. C. Mast

In cooperation with the Virginia Aberdeen Angus Breeders Association, the Experiment Station and Extension Service of the Virginia Polytechnic Institute started a program in January, 1953, to test the feasibility of measuring performance of beef cattle on the farm of the breeder. A total of 353 calves in twelve herds owned by nine breeders were weighed, graded and indexed. Each cooperating breeder completed and mailed to the College, soon after each calf was born, an individual birth record card that included the identification, parents, and the data taken at birth. Weights, type scores, and measurements were obtained during visits to each farm when groups of calves were between four and eight months of age. A portable scale was used to obtain weights. An index was computed for each calf based on weight at six months of age and type score. After each visit, the data were summarized and each breeder was furnished with a summary by sire, age of dam, and sex for the calves in his herd. The herds were scattered over seven different counties, and each herd was visited twice. On the basis of time spent in the field, it appears that a two-man team could visit and weigh and grade calves on at least two farms per day if the farms were not more than 30 to 40 miles apart, and had not more than 50 or 75 calves to be observed. It was concluded from this pilot program that a practical, useful program for the improvement of growth and quality of beef cattle could be achieved.

In 1954, the Virginia Legislature appropriated funds to employ a man to direct the program and make it more widely available to the beef cattle industry. Since available research information indicates that desirable beef type and growth rate should have equal emphasis, a grader with considerable experience as manager of purebred herds and a VPI graduate was employed by the State Grading Service to do the grading. During 1954, 26 breeders enrolled their herds with approximately 1100 calves and 300 yearling cattle. An index value was computed for each and the information sent to the breeder for his use in selecting his herd replacements. At the present time, there are about 75 herds enrolled.

A Board of Directors was established in January, 1955, to formulate policies and to guide the program in order that policies and practices would be standardized throughout the state. The Board has nine members; two from the Virginia Aberdeen-Angus Association, two from the Virginia Hereford Breeders Association, one from the Shorthorn Breeders Association, three from the Virginia Beef Cattle Producers Association, and one member-at-large selected by the Animal Husbandry Department of VPI.

In order to give equal weight to growth rate and to type and conformation of each animal, it was necessary to have an index. The index was meant to give an average calf an index value of approximately 100. In making the index, several factors had to be considered. In order that a direct comparison of progeny of different sires could be made, all calves were adjusted for difference due to sex. Data collected on several hundred calves owned by the Virginia Agricultural Experiment Station were used in arriving at these adjustment factors.

Growth rate of steer calves was used as the base and bull calves were adjusted downward by 3%; whereas, heifer calves were adjusted upward by 5% of their average daily gain from birth to weaning. To correct for the difference due to age of dam, 8% was added to the growth rate of the first calves. These adjustments may need further refinement as information is accumulated, but up to now the objective has been to make allowances for known factors that have an important influence on growth up to weaning.

A standard grading guide has been developed for this program using grade designations of fancy, choice, good, and medium. The numerical value assigned to each grade were those adopted for the Southern Regional Beef Cattle Breeding Program several years ago. The grade of fancy was given a value of 16, choice a value of 13, good a value of 10, and medium or commercial a value of 7.

The index for grade is obtained by multiplying the numerical value of the grade for each calf by 5. The index for weight is obtained by multiplying the adjusted gain per day of age by 40 and subtracting 18. For example, a calf grading good (10) with an adjusted gain of 1.7 pounds per day from birth would have an index of: (10 x 5) + (40 x 1.7 - 18) = 50 + 50 = 100.

ESTIMATES OF HERITABILITY AND RELATIONSHIPS AMONG TRAITS IN BEEF CATTLE

C. M. Kincaid and R. C. Carter (1)

I. Introduction:

For optimum progress in the improvement of economic traits in domestic species of livestock, it is necessary to have reliable estimates of heritability of each trait and genetic and phenotypic correlations among them. An experiment was started at the Virginia Agricultural Experiment Station in 1947 as part of the S-10 program to obtain direct estimates of the heritability of rate of gain in beef cattle through selection of bulls for high and low rates of gain on performance tests to be followed by progeny tests to compare the performance of their offspring. This paper reports five years of results from this experiment. Estimates of heritability of other traits have been calculated by several methods as well as genetic and phenotypic correlations among them.

II. The Investigation:

A. Bull Testing and Selection

Groups of young beef bulls were self fed in individual stalls for a period of about 168 days from late fall until about April 1. Most of the bulls were calves at or near weaning when star ed on feed except for two groups in 1949 which were about one year old when put on the feeding test. In the first two years of the experiment, the bulls were on loan from breeders. In the last three years, most of them were raised in the experimental herds at Front Royal with a few of them purchased from breeders. (2)

(1) Others who contributed to this work were B. M. Priode, J. S. Copenhaver, F. S. McClaugherty and J. C. Taylor.

(2) Except in the first year performance tests on the bulls were done at the Beef Cattle Research Station, Front Royal, Virginia.

At the end of the feeding period, the bulls to be progeny tested were selected solely on their rate of gain on the feeding test. With a few exceptions, the bulls selected were the fastest and slowest gaining bulls in their group. Usually about the fastest gaining 1/6th of the bulls and the lowest gaining 1/6th were chosen for the progeny test. The average performance of all bulls on feeding tests and that of the fast and slow gainers selected and progeny tested is shown in Table 1. The standard deviations were calculated from pooled variances within year, breed, and age group. It will be noted that for the selected bulls the average difference in daily gain between the fast and slow gaining bulls amounted to .56 lbs. per day which was almost exactly two times the standard deviation of daily gain.

Table I

Means and Standard Deviations of Certain Traits for all Bulls on Performance Tests and Those Progeny Tested

Group	All bulls on performance tests		Bulls selected and progeny tested: Fast Gainers	Slow Gainers	
Number	117		18	18	
	Mean	Standard Deviation	Mean	Mean	Difference
Initial Weight	536	94	572	582	-10
Gain					
Total	299	43	337	253	84
Per day	1.94	.28	2.22	1.66	.56
TDN per cwt. Gain	599	84	558	682	-124
Type Scores					
Initial	11.4	1.3	11.6	11.1	.5
Final	10.8	1.5	11.8	10.8	1.0

C. Progeny Test Matings

The test herd for the progeny tests was a herd of grade Hereford cows made up of sets of half-sibs. Contemporary bulls were paired according to breed and age for the test matings with one high gaining and one low gaining bullsbeing assigned to each pair. The cows were arbitrarily grouped into sets of equal number, each set consisting of several groups of half-sibs of the same age. Cows were assigned at random from among these half-sib groups to a pair of bulls so that each bull of a pair received an equal number of half-sibs from each set. From 10 to 16 cows were assigned to each bull depending on the number available but the same numbers were assigned to each bull within a year.(3)

(3)Of the 18 pairs of matings reported here, 17 were at Blacksburg and one at Front Royal.

After breeding season, the cows were handled as one herd. The cows were regrouped and rerandomized to bulls each season so that environmental correlation should be negligible. The calves were dropped in February, March and April and were run on pasture with their dams without supplemental feeding until weaning about October 10.

D. Performance Testing of Progenies(4)

All calves were weighed at birth and at 14-day intervals. Weights at 182 days of age were calculated for each calf. Each calf was graded as a feeder calf at weaning by a committee of 3 to 5. All calves were weaned at the same time within a year.

1. Steer Calves

At weaning all or a random sample of the steer progenies of each bull were put on a feeding test of about 200 days. The weaning weight was taken as the initial weight for the feeding test. Each calf was individually self-fed. The rations varied somewhat from year to year but was the same for all calves fed in the same year. Records were kept of individual feed consumption and weights taken every 14 days. At the end of the feeding test each steer was graded as a slaughter steer by a committee of 3 to 5, and then slaughtered at a nearby packing plant where carcass weights and grades were obtained.

2. Heifer Progenies

The heifer calves were weaned the same time as the steers, but were wintered largely on roughage to make gains of 1/2 to 3/4 lbs. per day during the winter feeding period. They were turned on pasture the latter part of April for a grazing test that terminated about October 15. During the first three years of the experiment, they were grazed on experimental pasture lots used to test methods of improvement of low grade pastures. These pastures are considered by the authors to below the average for this section of Virginia and the gains made by the heifers are thought to be below optimum pasture gain. In the last two years, the heifers were grazed on excellent quality bluegrass-white clover pastures at the Glade Spring Station and the gains were believed to be close to optimum for this area.

At the end of the summer grazing period, the heifers were graded as feeder yearlings by a committee and taken off the experiment.

III. Results:

A. Achievement from Selection

The results obtained from selection of the sires in opposite directions as measured by daily gains of their offspring, both steers and heifers, is shown in Table II. The heritability estimates were calculated according to the following formula.

$$h^2 = 2\left[\frac{\sum \overline{P_1 - P_2}}{\sum \overline{S_1 - S_2}}\right]\sqrt{\frac{\sigma_s^2}{\sigma_p^2}}$$

(4)All progeny tests for steers and three of five tests for heifers were at Blacksburg.

RESULTS OF SIRE SELECTION FOR HIGH AND LOW DAILY GAINS

Table II

Year	Sire Pairs	Sires: Av. Daily Gain High	Sires: Av. Daily Gain Low	Sires: Av. Daily Gain Dif.	Steer Progeny: Number High	Steer Progeny: Number Low	Steer Progeny: Av. Daily Gain High	Steer Progeny: Av. Daily Gain Low	Steer Progeny: Av. Daily Gain Dif.	Heifer Progeny: Number High	Heifer Progeny: Number Low	Heifer Progeny: Av. Daily Gain High	Heifer Progeny: Av. Daily Gain Low	Heifer Progeny: Av. Daily Gain Dif.
1949	H1	2.00	1.76	.24	4	5	2.24	2.16	.08	6	3	1.52	1.66	-.14
	H2	1.95	1.76	.19	5	1	2.22	1.73	.49	1	6	1.61	1.49	.12
1950	H3	2.36	1.62	.74	4	4	1.95	1.82	.13	4	4	1.41	1.53	-.12
	H4	1.91	1.20	.71	3	4	1.95	1.58	.37	5	8	1.54	1.40	.14
	H5	1.89	1.52	.37	4	4	1.90	1.84	.06	5	4	1.62	1.30	.32
	H6	1.83	1.45	.38	4	3	1.77	1.70	.07	4	7	1.33	1.36	.03
1951	A1	2.16	2.04	.12	4	4	1.84	1.81	.03	3	2	1.42	1.44	-.02
	A2	2.23	1.32	.91	3	3	1.90	2.05	-.15	7	5	1.48	1.38	.10
	H7	2.67	1.64	1.03	4	4	1.79	1.76	.03	5	5	1.29	1.33	-.04
	H8	2.02	1.70	.32	4	4	1.60	1.88	-.28	5	2	1.31	1.62	-.31
	SH1	1.95	1.68	.27	4	2	1.91	2.00	-.09	3	7	1.28	1.36	-.08
1952	A3	2.58	1.64	.94	5	5	1.73	1.73	.00	10	8	1.80	1.69	.11
	A4	2.62	1.77	.85	6	5	1.65	1.52	.13	7	5	1.95	1.77	.18
	H9	2.41	1.92	.49	3	2	1.54	1.20	.34	3	7	1.72	1.44	.28
1953	A5	2.38	1.61	.77	6	10	1.61	1.49	.12	5	5	1.92	1.60	.32
	H10	2.30	1.85	.45	8	5	1.64	1.55	.09	4	4	1.86	1.64	.22
	SH2	2.42	1.45	.97	5	7	1.70	1.58	.12	5	5	1.83	1.72	.11
	H11	2.26	1.92	.34	12	10	1.83	1.80	.03	6	5	1.73	1.85	-.12
		39.94	29.85	10.09	88	82	32.77	31.20	1.57	88	92	28.62	27.58	1.04
		2.22	1.66	.56			1.82	1.73	.087			1.59	1.53	.058

$$h^2 = 2\left(\frac{.087}{.560}\right)\left(\frac{.284}{.203}\right) = .43 \qquad h^2 = 2\left(\frac{.058}{.560}\right)\left(\frac{.284}{.210}\right) = .28$$

Where h^2 = the hereitary portion of the total variance

P_1 = performance of progeny of sire 1 (high)

P_2 = performance of progeny of sire 2 (low)

S_1 = performance of sire 1 (high)

S_2 = performance of sire 2 (low)

σ_S^2 = within group variance of the bulls from which the sires were selected

σ_P^2 = within group variance of the progeny

The heritability of daily gains of the steers was estimated at .43 and of the heifers at .30.

Differences between progenies of fast and slow gaining sires within pairs showed somewhat the same trend. Of the 18 pairs, 8 were definitely positive (favored progeny of the fast gainers) for both sexes, 2 were definitely negative and 8 were either small or disagreed in direction. Weight at 180 days agreed rather well with results in the feeding and grazing tests.

If the distribution of real breeding value of sires in these data was 2/3 above and 1/3 below average for fast gainers, and 1/3 above and 2/3 below average for slow gainers; random pairing of fast and slow performing bulls would be expected to result in paired differences that showed 4/9 positive and 4/9 near zero, and 1/9 negative. The observed paired differences fit this expected distribution rather well.

B. Heritability Estimated by Paternal Half-Sib Method

Heritability of various characters estimated by the paternal half-sib method is shown in Table III. These estimates were made by the following formula:

$$h^2 = \frac{4\,\sigma_s^2}{\sigma_s^2 + \sigma_e^2}$$

Where: σ_s^2 = the sire component of variance

σ_e^2 = the within sire progeny variance

C. Heritability Estimates from Regression of Offspring on Parent

Estimates of heritability of the various traits calculated by the method of parent offspring regressions are shown in Tables IV and V. Both regressions of progeny average on sire and intra-sire regressions of off-spring on dam were calculated. The formula used to estimate heritability was:

$$h^2 = 2\left[\frac{\sum X_1 X_2}{\sum X_1^2}\right]$$

Where: X_1 = trait X in the parent

X_2 = trait X in the offspring

Table III

Heritability Estimates from Paternal Half-Sib Analysis

Traits	Steers	Heifers
6 months weight	.08	.74
Feeder grade at weaning	.49	.57
Daily gain in feed lot or on pasture	.30	.56
TDN per Cwt.	1.04	
Slaughter grade	.53	
Carcass grade	.16	
Yearling feeder grade		.20

Table IV

Heritability Estimates from Regression of Progeny Average on Sire

Traits	Steers	Heifers
Feeder grade at weaning on sires initial grade	.16	.63
Daily gain in feed lot or pasture on sires daily gain in feedlot	.21	.20
TDN per Cwt. gain	.22	
Progenies slaughter grade on sires final grade	.07	
Yearling feeder grade on sires final grade		.002

Table V

Heritability Estimates from Intra-Sire Regressions of Offspring on Dam

Traits	Steers	Heifers
Feeder grade at weaning	.07	zero
Daily gain in feed lor or on pasture on dams pasture gain	.40	.57
Yearling feeder grade		.32

Table VI

Genetic and Phenotypic Correlations[1]

STEERS

Trait	Feeder Grade	Daily Gain	TDN/Cwt Gain	Slaughter Grade	Carcass Grade
6 months weight	.45 (.54)	.69 (.27)	.43 (.45)	.35 (.48)	.85 (.24)
Feeder grade		.31 (-.10)	-.10 (-.45	.36 (.40)	.60 (.32)
Daily Gain			-.33 (-.45)	.48 (.29)	.27 (.25)
TDN per Cwt gain				.14 (.02)	.05 (.02)
Slaughter grade					.84 (.71)

HEIFERS

Trait	Feeder Grade	Daily Gain on Pasture	Yearling Feeder Grade
6 months weight	.31 (.37)	.51 (.20)	.50 (.28)
Feeder grade		-.0004 (-.02)	.63 (.56)
Daily gain in pasture			.59 (.0002)

(1) Genetic correlations (top figure in each cell) by paternal half-sib method. Phenotypic correlations in parenthesis.

VI. Discussion:

The estimates of heritability of rates of gain obtained from selection of sires for rapid and slow gains are substantially lower than those previously reported in the literature particularly the estimates obtained from half-sib correlations. (Knapp and Nordskog, 1946; Knapp and Clark, 1947; Patterson et.al., 1949; Knapp and Clark, 1950; and Shelby, Clark and Woodward, 1955). If $\left(\sqrt{\frac{\sigma_S^2}{\sigma_P^2}}\right)$ the correction for differences in variances is omitted, our estimates reduce by about 1/3 to 31% for the steers and 20.8% for the heifers. These estimates are much closer to those of Cartwright (1955) and Warwick and Cartwright (1955). These estimates are much closer to estimates of heritability of post weaning rates of gain for other species including swine (Craft, 1953; Rendel 1950) and sheep (Hazel and Terrill, 1945, 1946).

The authors recognize that the numbers involved in this study are much too small for reliable estimates of genetic correlations. One such correlation, however, is believed to warrant attention, that between 6 months weight and post weaning daily gain. In both the steers and heifers, the genetic correlation between these two traits is fairly high (.69 and .51) and much higher than the respective phenotypic correlation, (.27 and .20). This indicates that the same genetic influence is operating, at least in part, both before and after weaning. This is also reinforced by the differences in 6 months weight between the progenies of the fast and slow gaining bulls. The steer offspring of the bulls selected for past post-weaning gains averaged 9 pounds per head heavier at 182 days of age and the heifers 20 pounds more per head than the progeny of the low gaining bulls.

VII. Conclusion:

From this study it is concluded that:

1. Heritability of growth rate in cattle is in the neighborhood of 1/3.
2. Something like 1/3 of bulls above average on their own performance were near or below average in breeding value.
3. Performance testing to identify bulls with high potential breeding value followed by progeny testing to weed out those with below average breeding value is likely to give faster progress per unit of time than performance testing alone.
4. Genetic correlations in this study between 6 months' weight and gain in subsequent test periods indicate that growth rate up to weaning may be used to measure the breeding value of sires with respect to growth rate if the sires are all mated to the same kind of cows.
5. The relationship between feeder grade and subsequent gains on test was essentially zero or negative.

EFFECT OF DATE OF CALVING ON SUBSEQUENT CALVING PERFORMANCE

Martin Burris

The breeding season in many beef cattle herds is restricted to a certain season of the year and its duration is usually limited to a few weeks or months in order that calving may be concentrated at a time of year deemed most desirable by the cattleman for calving and subsequent livability and growth. Failure

of an individual cow to conceive during the breeding season means failure to calve in the following calving season and no economic return from the cow for that entire year. If failure to calve is in anyway dependent on previous performance of the individual it is important to know the association between past and present calving performance.

Material and Methods:

Calving records of cows now in the Angus, Hereford and Shorthorn herds at Front Royal Beef Cattle Research Station were used in this study. Calving dates were converted to day of the year (ie. Jan. 1 is 1, April 10 is 100, etc). Calving dates were divided into two groups on the following basis: All birth dates of calves from cows which calved the following year were placed in one group, and all birth dates of calves from cows which did not calve the following year were placed in the second group. Differences between the two groups above were calculated for the Angus, Shorthorn and two Hereford herds. The percent of cows calving each month which failed to calve the following year was calculated for each of these breeds.

During the years which these data were collected the breeding season was of about 90 days duration for each breed. However, the beginning of the breeding period was changed from May 1 to April 1 in 1953. The Angus herd and the State Herefords are comparatively young herds and most of the calving records included were in 1953, '54, and '55. The share Hereford herd was comprised primarily of old cows and the calving records are evenly distributed from 1950 to 1955. The Shorthorn herd includes cows of ages up to 12 years old and calving records from 1949 to 1955 were used. Records on cows calving from January 1 to July 1 were used although in some cases the cows were not bred at this station.

Table I

Effect of Date of Calving on Subsequent Calving

	Average birth date of calves from cows which: (a) calved the next year.	(b) did not calve the next year	(b) - (a)
Hereford (owned)	77.4* (91)** March 18	101.7 (22) April 12	24.3
Hereford (share)	80.1 (130) March 21	98.4 (42) April 8	18.3
All Herefords	79.0 (221) March 20	99.5 (64) April 10	20.5
Angus	61.1 (119) March 2	76.6 (17) March 18	15.5
Shorthorn	69.3 (236) March 10	89.4 (58) March 30	20.1
Av. of 3 breeds	69.8 March 11	88.5 March 30	18.7

*Indicates day of year (ie. Jan. 1 is 1, Apr. 10 is 100)
**Number of animals in average

Table II

Percent of Cows Calving Each Month Which Did Not Calve the Next Year

	Hereford (share)	Hereford (owned)	All Herefords	Angus	Shorthorn	All Cattle
January	28.6 2/7*	06.3 1/16	13.0 3/23	03.8 1/12	08.3 2/24	10.2 6/59
February	13.3 6/45	11.1 3/27	12.5 9/72	08.8 5/57	11.4 10/88	11.1 24/217
March	20.0 10/50	20.0 4/20	20.0 14/70	12.5 4/32	19.6 21/107	18.7 39/209
April	28.9 11/38	20.0 5/25	25.4 16/63	18.8 6/32	28.8 15/52	25.2 37/147
May	42.9 9/21	46.7 7/15	44.4 16/36	33.3 1/3	25.0 4/16	38.2 21/55
June	36.4 4/11	20.0 2/10	28.6 6/21	- - - -	85.7 6/7	42.9 12/28

*Fraction used to determine the percent x 100

Numerator = cows calving in one year and not in following year

Denominator = numerator plus cows calving in one year and also in the following year

Morning Session - September 8, 1955

The meeting was called to order by Chairman Marvin Koger at 8:30 a.m. The first items on the program were talks by W. R. Harvey and E. J. Warwick. These follow:

PROBLEMS IN ANALYSIS OF BEEF CATTLE BREEDING DATA

Walter R. Harvey[1/]

Breeding experiments in large animals should be primarily designed to discover ways of maximizing genetic progress. Genetic progress is defined as the difference between the performance of subsequent generations after adjusting for environmental differences. One of the most important methods of increasing the genetic merit of a herd is with selection. The process of selection involves the estimation of breeding values. Research workers in livestock breeding are constantly attempting to improve the accuracy of prediction equations for estimating breeding values. Reliable estimates of genetic and environmental parameters are necessary in order to establish useful prediction equations.

Estimates of genetic and environmental parameters are often obtained from data where the design of the experiment was established for a different purpose. Even when the experiment is designed to obtain answers of this sort the analysis is often complex. Caution must be exercised in order to avoid biases from resulting in the estimates of the genetic parameters. Improper adjustment for major environmental effects or inaccurate corrections for non-random mating systems can easily result in biased estimates. Random errors due to small numbers can often account for highly variable results obtained from one station to another.

In any proposed experimental livestock breeding program it is important to not only make detail plans for the data to be recorded, but equally important to know what use will be made of the records after they are collected. Recognizing the fact that each animal costs a great deal, too often research men in animal breeding work have been over zealous in the collection of data to the detriment of the proper consideration of the important performance records for selection. The time spent in the collection of unimportant information can more wisely be used in summarizing and analyzing the more valuable data. The use of electrical computing equipment, in a number of cases, has relieved the research man of much of the burden of record keeping, preparation of progress reports, and the analyses of data. Greater use of machines of this type to handle the processing of data collected in animal breeding experiments is highly desirable.

Unless genotype by environment interactions are expected to be important, an animal breeding experiment should be conducted so that the more important environmental effects are held constant or so that they can be separated from the genetic effects in the statistical analyses. Such factors as age when bred, yearly climatic and nutritional changes, and sex, cannot usually be held constant from one breeding group to another. However, efforts should be made to see that each breeding group such as sets of half sibs, lines, etc., receive each of these effects about equally. Many environmental factors which affect performance

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can be held constant or be allowed to vary only slightly during the course of an experiment. These include such things as general nutritional level, time of castration, length of feeding period, ratio of hay to grain fed to steers in the feed lot, weight at slaughter, type of housing from time-to-time, frequency of milking dairy cows, etc. Careful planning before the experiment begins cannot be overemphasized.

In breeding experiments where the primary objective is to develop superior breeding stock for release to breeders it is essential that selection procedures be as accurate as possible. It has been well established that genetic merit (whether selection is on several traits or on only one trait) will be improved faster when selection is based on a selection index than when selection is based on any other known criteria. Even though reliable estimates of all of the parameters required to construct a selection index are not available in the initial phase of an experiment, an approximate index can be used as a guide until it can be revised from data collected early in the experiment. Since most traits of economic importance in farm animals have been found to be low in heritability, it is usually desirable to include the consideration of records on close relatives in the prediction equation(s) for estimating breeding values.

Analytical Methods Currently Being Used

In the analysis of data from beef cattle breeding experiments some consideration must usually be given to major environmental effects such as years, age of dam, and sex of calf. If reliable adjustment factors for effects such as these are known from outside the data the problem is very much simplified. The data are then adjusted for such effects before attempting a genetic analysis. Interactions of major environmental factors with breeds, herds, climatic conditions, etc., however, seem to prevent the use of common adjustment factors in many instances. This is illustrated by some recent work reported by Hickman and Henderson (2) which shows clearly that standard age adjustment factors for lactation production in dairy cows are greatly inaccurate when used in some herds.

The necessity of adjusting for the non-random environmental effects by statistical means has been generally recognized by research workers since the beginning of the study of genetic variation in quanitative characters. At first, the adjustment factors were determined from the differences between overall means. Some factors are still being determined in this fashion. However, as statistical methods have developed adjustment factors generally have been refined so that errors in estimating breeding values may be kept to a minimum.

Statistical methods required to accurately estimate correction factors for major environmental influences ("fixed effects") are usually complex when dealing with livestock breeding data. This is because each of the genetic ("random effects") and major environmental effects are seldom equally present from one subclass to another. Therefore, at least partial confounding of the genetic and environmental effects generally exists. In order to obtain unbiased estimates simultaneous consideration must be given to all sources of variability when reliable adjustment factors for the important environmental effects are unknown.

Recently, a number of research workers have been giving considerable attention to the possibility of making adjustments for some of the more importan

environmental effects by simply expressing each record as a deviation from the respective subclass[1] mean. In order to avoid negative numbers, essentially the same results can be accomplished by dividing the observation by the subclass mean and multiplying by 100 as was done by Warwick and Cartwright (3) for feed lot gain and termed "gain ratio". Since the genetic composition of the groups of animals which contribute to the different means will, in most cases, be different this method removes some of the genetic differences. In addition, some of the genotype by environment interactions will be removed if relatives are present in different subclasses. However, unless the genetic and environmental classifications, such as sires and years, are orthogonal some of the genotype by environment interactions will remain and will bias the heritability estimate upwards.

The size of the errors resulting in the determination of heritability estimates and other genetic parameters from the procedure of adjusting for fixed effects by expressing each record as a deviation from the subclass mean will depend on (i) the non-orthogonality of the data, (ii) the importance of the fixed effects, and (iii) Mendelian chance at segregation and other random errors, Since the number of animals in some of the subclasses is likely to be small all random errors may become very important.

The method of deviations from subclass means to adjust for important environmental effects generally will be better than attempting to estimate genetic parameters when those effects are ignored. Whether such a method is better than deriving adjustment factors from overall means will depend on the interactions among the environmental factors. If no interaction exists among the environmental factors then the latter method of estimation is superior since sampling errors will be less important.

When adjustment has been made separately for the important environmental effects the remaining analyses for the genetic parameters, such as heritability and phenotypic and genetic correlations, is either with a simple one-way classification or nested classifications based on kinship of the animals. An analysis of this type is straight forward. Methods of estimating sampling errors associated with such estimates however, are still largely unavailable.

A second method of estimating genetic parameters while simultaneously considering major environmental effects is to calculate the genetic differences on an intra-environmental classification(s) basis. In other words, the genetic classifications are nested within the environmental classifications. For example, the classifications of years, and sires within years are often used even though some sires were used in more than one year. The method is also often extended to more than one environmental classification. An analysis of this type will provide unbiased estimates of the genetic parameters provided no interaction between genotype and any one of the environmental factors exists. The nested classification analysis does not provide correction factors for any of the

[1]Subclass mean is used here to designate any mean obtained by two or more environmental classifications. If the observations are expressed as a deviation from the overall means of a one-way classification the results are identical, of course, with those obtained by first determining adjustment factors for the means and then adjusting the data.

environmental effects nor does it provide any test of significance for a possibl genotype by environment interaction. Tests of significance for the main effects of the environmental factors can only be obtained after expectations of all mean squares have been determined. Even then, the tests of significance are only approximate.

Henderson (1) gives three methods for estimating variance components from breeding data when the important environmental factors and the genetic differences must be considered simultaneously. Method 1 requires the least labor for the computations but should only be used when all environmental classifications can be assumed to be random variables. This method consists of computing the sums of squares as though the data were orthogonal, equating these sums of squares to their expectations, and solving the resulting set of equations. Genetic parameters derived from such estimates are biased if the assumption that the environmental factors are random was not valid.

Henderson's Method 2 is a least squares method wherein the equations for the random variables are absorbed into the equations for the fixed effects. The reduced set of equations is then solved simultaneously to obtain correction factors for the fixed effects. The inverse of the reduced set of equations is used together with different matrices formed from the various class or subclass frequencies to derive expectations of the corrected sums of squares for the classifications of the random variables. Henderson shows how to obtain the corrected sums of squares without actually correcting the original data with the correction factors.

Method 2 may also give biased estimates if certain interactions among the factors considered exists and these are not included in the model used. However Method 2 does eliminate the bias obtained when Method 1 is used and some of the effects considered are actually fixed rather than random. In addition, Method 2 provides exact tests of significance for the fixed effects and approximate tests of significance for the effects of random variables. Genetic variances and covariances are estimated from the sums of squares of the random classifications and their expectations after adjusting for the major environmental effects.

Method 3 is the conventional least squares analysis in which the solution and inverse of all equations must be obtained. In addition, the solution and inverse of coefficient matrices in which one of the classifications has been omitted seems to be necessary. The inverses of these matrices are used to compute the expectations of mean squares in the analysis of variance.

Since Method 3 avoids the difficulty of fixed elements in the model and yields unbiased estimates of the genetic parameters even though certain interactions exist it is to be preferred when computationally feasible. However, when numbers are large enough to provide fairly reliable estimates of the genetic parameters it is unlikely that Method 3 will be computationally feasible unless high speed electronic calculating equipment is available.

Biases will exist in estimates of genetic parameters from non-orthogonal data when (i) correction factors for environmental effects are used which were derived from the same data without any consideration being given simultaneously to genetic effects, (ii) Method 1 of Henderson is used and certain of the effects are actually fixed rather than random, (iii) the genetic effects are nested within the environmental classification(s) and a genotype by environment

interaction exists, and (iv) Method 2 of Henderson is used and certain interactions among the elements of the model exist but are ignored in the analysis. All of these biases can be eliminated by selecting the proper method of analysis. In some sets of data, several different methods of analysis may provide unbiased estimates. Since no exact methods exist for determining the relative sizes of the sampling variances of estimates obtained by the different methods of analysis the investigator should choose the one which requires the least time for computations.

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SERVICE AND ADVISORY FUNCTIONS OF BIOMETRICAL SERVICES OF THE AGRICULTURAL RESEARCH SERVICE, U.S.D.A.

Walter R. Harvey

Biometrical Services was established on December 29, 1953 by Administrative Memorandum No. 103.1 issued by Dr. B. T. Shaw, Administrator of Agricultural Research Service. A budget was established for this organization on July 1, 1954. Dr. E. L. LeClerg, who had been active in the direction of a survey of the Agricultural Research Service prior to December 1953 to establish the need for such an organization, was appointed Chief of Biometrical Services.

The responsibilities of the members of Biometrical Services are given in Administrative Memorandum No. 103.1. These are to "review ARS research programs with reference to the planning and designing of experiments, sampling methodology, statistical interpretation of experimental data and related statistical implications and to lend assistance and make recommendations regarding the conduct of investigations in this field". It is further stated that "The staff will render services to research personnel but will not have authority to change program operations or have administrative or operational responsibilities for them".

General functions of Biometrical Services are also described in Administrative Memorandum No. 103.1. These are as follows:

"A. Consultation: Consult on experimental design and related statistical problems.

1. In the development and planning of research investigations.

2. In the analysis and interpretation of data for the preparation of publications.

B. Training: Promote increased knowledge and competency of the research staff through seminars, short courses and other appropriate means.

C. Research: Develop new and improved statistical techniques in agricultural research including the adaptation and modification of existing techniques, and maintain relationships with statistical research groups necessary to achieve this end.

D. Computing Services: Provide, within available resources, limited services to members of the research staff".

Biometrical Services, at the present time, consists of three men on the Plant Industry Station Staff, two men on the Livestock Research Staff and the Chief of Biometrical Services. In addition, there are two statistical clerks and three secretaries. A position for a Mathematical Statistician in the office of the Chief has not been filled.

AMOUNT OF SELECTION POSSIBLE IN BEEF CATTLE

E. J. Warwick

The amount of selection possible in beef cattle cannot be considered a constant thing from herd to herd since the magnitude of neither genetic nor environmental variation is likely to be the same in all herds.

The calculations which follow represent an attempt to show what selection intensity might be possible under a few assumed sets of conditions. Assumptions are as follows:

1. All characters normally distributed with standard deviations as follows

   Weaning weight - 40 lbs.
   Post weaning daily gain - .30 lb. for males
   and .25 lb. for females
   Conformation scores - .6 grade where grades are
   fancy, choice, good, etc.

2. All selection of truncation type and, except as noted, for one character at a time.

3. Where necessary in computing selection differentials on the basis of cow performance, repeatability of weaning weight of calves from same cow was assumed to be .40. Similarly, the standard deviation between sire progenies in average post weaning gain was assumed to be .20 lb. (Actual Virginia figures = .15 and Miles City figures = .29). No other assumptions made regarding heritability or repeatability.

4. Eighty percent calf crop and a 50:50 sex ratio assumed.

5. All cows culled after 10 years for age if not culled earlier for performance.

6. Cows bred to calve first as three-year-olds.

7. Weaning weight considered as a character of the individual. If it were considered solely a maternal trait, the selection differentials would be half those given.

All selections were put in terms of annual selection differentials by the use of the following formula developed by G. E. Dickerson (See 1952 S-IO minutes):

$$\Delta P = \frac{N_1^s S_1 + N_2^s (S_1 + S_2) + N_1^d D_1 + N_2^d (D_1 + D_2)}{N_1^s A_1^s + N_2^s A_2^s + N_1^d A_1^d + N_2^d A_2^d}$$

where: N_1^s, N_2^s, N_1^d and N_2^d are the proportions of all progeny from each age-sex group of parents; S_1, S_2, D_1 and D_2 are selection differential increments from the first and second cullings among bulls and females; and A_1^s, A_2^s, and A_1^d and A_2^d are ages in years for each group of parents. Where necessary the formula was extended to more than two successive cullings.

Calculations were made on the basis of three selection and culling programs among cows in a herd of constant size: (I) 34 3/4 percent of heifers saved for replacements, none culled later; (II) 47 1/2 percent of heifers saved and 10 percent of these culled solely on weaning weights of calves after each calving; and (III) All heifers saved and 50 percent culled on basis of weaning weights of calves after one calf, 50 percent of those remaining after two calves, and 27 percent of those remaining after three calves. A constant 3 percent attrition from death and sterility was assumed in all cases.

Age composition of herds of 1,000 cows under these three plans would be as follows:

Age	No. cows Plan I	Plan II	Plan III
3	139	190	400
4	135	166	194
5	131	146	94
6	127	128	67
7	123	112	65
8	119	98	62
9	115	85	60
10	111	75	58
	1,000	1,000	1,000

Calculations were made on basis of three plans for selecting and culling sires as follows:

Plan A: Forty bulls selected and each bred as yearlings to 25 cows. No bulls saved for more than one calf crop.

Plan B: Twenty bulls selected each year and used for two years on 25 cows each year, then replaced.

Plan C: Twenty-five bulls selected each year and bred to 20 cows each as yearlings. They are held out of service next year and on the basis of progeny performance the top 20% are returned to herd and used on 33 or 34 cows annually for three years.

Possible Annual Selection Differentials

		Cow Herd		
		Plan I	Plan II	Plan III
I. Weaning Weight (lbs.)				
Sire	A	13.8	17.4	20.1
Plans	B	15.5	17.9	
II. Daily post weaning gain (lbs.)				
Sire	A	.096		.077
Plans	B	.101		
	C	.111		
III. Conformation Scores (Grades)				
Sire	A	.208		.153
Plans	B	.216		

The above selection differentials should represent near maximums when each character is considered separately. If each of the three characters are independent, selection for all three simultaneously would reduce the selection differentials for each one by $\frac{1}{\sqrt{3}}$. Thus under cow herd Plan I and bull Plan A, selection differentials would be 8.0 for weaning weight; .055 for post-weaning gain and .12 for score.

Selection under schemes where one character is emphasized ~~is emphasized~~ in the sires and another in the dams may be of interest. For example, if the bulls were handled under plan A and selected entirely for rate of gain while the cows were handled under plan III and selected entirely for weights of calves, annual selection differentials would be .077 and 9.9, respectively.

It should be emphasized that heritabilities and genetic correlations have not been considered in the above calculations - thus no implication should be drawn regarding effectiveness of selection.

These talks were followed by a symposium on "Virtues and Limitations of Selection Indexes" led by Dr. R. E. Comstock. The papers given follow:

BASIC INFORMATION NEEDED TO CONSTRUCT A SELECTION INDEX

R. E. Comstock

Selection of breeding stock implies choice of individuals that are superior in breeding value to the average of those among which selection is practiced. Because individuals vary in numerour characters a decision of some sort must be made concerning the relative emphasis to be placed on different traits in the criterion by which selection is actually affected. This decision may be made in an arbitrary fashion but the necessity for making it cannot be dodged. The question is not whether we should use a selection index (criterion) but what kind of index it should be.

The problem of constructing an efficient selection index, one that maximizes the true superiority of selections, was considered from a theoretical point of view by Smith (1936) and by Hazel (1943). Most, if not all, of you are

familiar with the solution they reached. A selection index constructed on the principles they outlined will be referred to as an S-H (Smith-Hazel) index to distinguish it from indexes arrived at in any other way, arbitrary or otherwise. I shall consider briefly (a) the basic information required for construction of an S-H index and (b) factors bearing on the effectiveness of such an index. Following symbolism employed by Hazel (1943), an S-H index is a linear function of phenotype in n traits, i.e.,

$$I = b_1X_1 + b_2X_2 + \ldots b_iX_i + \ldots b_nX_n \qquad (1)$$

where X_i is phenotypic value for the i-th trait, and b_i is a weighting coefficient for the i-th trait. (b_i may be negative, positive, or zero. If it is zero it simply means that the corresponding trait receives no attention in selection. When certain traits are ignored in the construction of an index, their weighting coefficients in effect have been made zero arbitrarily.)

Assuming linear relations between net economic value and each of the individual characters, the net value of genotype may be written as

$$H = a_1G_1 + a_2G_2 + \ldots aa_iG_i + \ldots a_nG_n \qquad (2)$$

where G_i is genotype for the i-th trait (in terms of the unit used in measuring phenotype of the same trait), and a_i is the relative economic value associated with a unit difference in phenotype of the i-th trait.

Assuming linear relations in the co-variation of both the genetic and non-genetic portions of phenotype in all traits, the optimum weighting coefficients (b's) are given by a set of simultaneous equations of the following form (given by Hazel):

$$\beta_1 r_{X_1X_i} + \beta_2 r_{X_2X_i} \cdots + \beta_i \cdots + \beta_n r_{X_iX_n} = r_{X_iH} \qquad (3)$$

where $\beta_1 = b_1\sigma_{X_1}/\sigma_H$, $\beta_2 = b_2\sigma_{X_2}/\sigma_H$, etc.

Hazel showed that each of the correlations signified by r_{X_iH}, i.e., r_{X_1H}, r_{X_2H}, etc., is a function of heritability of the i-th trait, the genetic correlations of the i-th trait with every other trait, and the relative economic values (a's) for the several traits.

From the foregoing we see, what most of you already knew, that the basic information required for construction of an S-H index consists of estimates of

1. the phenotypic and genotypic correlations among the different traits (including, properly, all traits having a direct effect on economic value and all other traits tentatively considered worthy of attention in selection),
2. the heritabilities and phenotypic variances of the several traits, and
3. the relative economic values of the various traits.

Since heritability is the ratio of genetic to phenotypic variance and correlations are functions of variances and covariances, the information required could be stated alternatively as consisting of estimates of

1. the phenotypic and genotypic variances and covariances of the various traits, and
2. the relative economic values of the various traits.

(Within the context of this communication both "genotypic" and "genetic" have reference solely to "additive genetic" effects. For example, genotypic correlation or covariance refer to the correlation or covariance of additive genetic effects.)

Estimates of quantities listed (either list) other than relative economic values are obtained from data in ways with which you are more or less familiar and will be considered by other members of this panel.

Estimates of (or approximations to) the relative economic values of the traits require logical analysis of the factors bearing on profit in the livestock enterprise, supplemented by price information on cost items and the market product or products of the enterprise. Briefly, what is required is to write an expression for profit from raising beef cattle as a function of the characters or traits that affect it directly and then note the difference in profit resulting from unit change in each character when all others are held constant. It should be noted that in general only those characters that appear in the expression are properly given an economic value. Which these are may vary depending on the precise form of the expression written. For example, live beef for market (an inevitable component of profit) may be expressed in terms of birth weight and daily rate of gain in which case both these traits are properly accorded economic value. Alternatively, beef for market might be expressed in terms of weight attained at a specified age in which case this particular measure of growth rate should be accorded economic value and the a's for daily rate of gain and birth weight set at zero. (A possible exception would result if, for example, value were attributed to birth weight because of a relation to average calf mortality and lack of a more direct way of giving attention to mortality.)

Uncertainties are always introduced in connection with information on relative prices, e.g. for feed, labor, and beef of different grades. Price relations vary cyclicly and may be subject to long time trends. Because of time involved in affecting genetic change through selection, it would appear that cyclic variations must be ignored in favor of long time average relations. On the other hand long time trends should be predicted to the extent that it is possible to do so.

Recognizing that some uncertainties and approximations are inevitable, I am of the opinion that satisfactory estimates of relative economic value always can be made if the factors bearing on profit are carefully placed in logical perspective.

The other question to be discussed is whether an S-H index should be used at all. To raise this question is not to reflect on the validity of arguments by Smith and Hazel for the efficiency of the index they described. Their arguments began with assumptions: (1) of linearity in the relations among the variations (genetic and non-genetic) in different characters, and (2) that relevant population parameters were known. Granting these assumptions there appears no reason to question that maximum effectiveness is attained with the S-H index. Actually, we know the second assumption never holds: we never know the parameters exactly but instead must employ estimates which very frequently have wide confidence limits. Nor is the first assumption necessarily likely to

be strictly correct in many instances. It is for example easy to describe a situation in which genotype and phenotype relative to the same trait would not be linearly related.

As an alternative to an S-H index one might with some justification use an index in which characters were weighted in accord simply with their relative economic values. This would mean selection on the basis of net economic value if all traits contributing to value were employed in the index. To provide an example of the effect of errors in the estimates of population parameters on the relative efficiency of an S-H index, I have made some computations to extend the example given by Hazel (1943). For simplicity, attention is restricted to indexes involving only 180 day weight (W) and market score (S).

Hazel defined breeding value as a linear function of genotypes in weight, score and sow productivity (P); his definition is retained. Hazel's estimates of parameters were as follows:

Parameter	Estimate
Phenotypic variance of weight, σ^2_w	$(31.86)^2$
Phenotypic variance of score, σ^2_s	$(4.78)^2$
Phenotypic correlation of W and S, r_{SW}	.614
Heritability of weight	.30
Heritability of score	.10
Heritability of productivity	.16
Genetic correlation of W and S	.52
Genetic correlation of W and P	00
Genetic correlation of S and P	00

Employing these estimates, the S-H index for selection on the basis of weight and score turned out as

$$I_1 = .137W - .268S$$

On the other hand if weighting were relative to economic value, the index would be

$$I_2 = \frac{W}{3} + S$$

Indexes can be compared in terms of average progress that would result from their use as the basis for selection. Without giving details, I will simply note that expected progress can always be computed for any index for any assumed set of population parameters (the procedure involves the same linearity assumption that lends us to the S-H index as most efficient given knowledge of the population parameters). Expected progress was computed for each of the above indexes and the following three assumptions concerning population parameters:

1. That the parameters were exactly as estimated by Hazel.
2. That heritabilities of weight and score were .25 and .20, respectively (instead of .30 and .10 as estimated) and other parameters were as estimated.
3. That heritabilities of weight and score were .25 and .20, the genetic correlation of weight and score was .65 (instead of .52 as estimated) and other parameters were as estimated.

The latter two cases represent quite moderate, and entirely possible, deviations of real from estimated values of parameters and hence should serve satisfactorily to suggest how the S-H index may suffer as a consequence of lack of adequate estimates of parameters. Results of computations were as follows:

Case	Expected Progress	
	I_1	I_2
1	3.72 k	3.19 k
2	3.01 k	3.16 k
3	3.07 k	3.37 k

k is a constant reflecting selection intensity. In case 1, expected progress is greater by I_1 in accord with the demonstration by Smith and Hazel that, granting their assumptions, the S-H index is most efficient. In the other two cases the use of slightly erroneous estimates of parameters led to an index slightly less effective than one obtained by arbitrarily weighting the traits in accord with their relative economic weights.

The above demonstration that an arbitrary index may sometimes be more effective than an S-H index (because of errors in the estimates of parameters employed in construction of the latter) is not intended to suggest how often this will be true but only to emphasize the possibility. The subject is one which needs investigation aimed at determining the liklihood of less rather than more effective selection when an S-H index is used. We might sum it up by saying that one piece of basic information needed to guide us is specification of precision required in estimates of population parameters to insure than an S-H index will be superior (or at worst, not gravely inferior) to one established by any other designated criterion for weighting a series of traits.

Time does not allow any detailed consideration of the linearity assumption. However, a simple example which you may or may not consider far-fetched, will serve to demonstrate that non-linearity can, at least in theory, be of some importance. Given over-dominance in the actiom of one or more pairs of alleles (or chromosome blocks) with respect to affects on a single trait, the trait in question would, after considerable selection, tend to exhibit no additive genetic variance though still segregating. With no additive genetic variance there would be no correlations in additive genetic effects between this trait and any others. At this stage an S-H index constructed from accurate estimates of parameters could give either zero or negative weight to the trait (negative weight would result from positive correlation in environmental effects between the trait in question and others of economic importance that exhibited some degree of heritability). Now if zero weight were given it is easy to visualize that frequencies of genes affecting the character might be changed as a consequence of attention to other characters affected pleiotropically by the same genes. This would result in deterioration in the character on which we've focused attention, a fact not recognized in computation of expected progress under the linearity assumption.

Likewise if our trait receives negative weight, this alone could result in unfavorable genetic change with respect to this trait even though it initially exhibited no additive genetic variance. That a trait can respond to negative but not to positive selection in the circumstance described can again be interpreted in terms of non-linearity. How important considerations suggested by

the foregoing may be remains to be seen, but again it seems fair to note that the linearity issue poses a need for relevant basic information.

As an entirely personal reaction I am inclined to the view that the difficulties of obtaining adequately precise estimates of population parameters and of understanding the pleiotropic and functional relations among characters precludes a priori certainty concerning the best selection index. I'm confident that extension of theoretical considerations and careful analysis of data as it accumulates will provide improved guides to practical procedure. In the meantime there is probably justification in suggesting that all traits contributing to economic value always be given a degree of positive weight in selection. This would in some cases represent a moderate departure from an S-H index constructed in terms of available parameter estimates. It is possible (though I can't be any more positive) that weighting relative to economic importance will be nearly as effective as anything else in most cases. This would represent a conservative approach that in some cases would be somewhat less effective than the best thing that could be done but never likely to be a thoroughly bad procedure. Another rule that suggests itself is to weight by the product of relative economic value and heritability subject to the proviso that at least some positive weight be given to all traits contributing to net economic value.

Whatever the choice of selection index it appears that the breeder must depend on his own awareness of what his selection is doing in terms of over-all genotype in his herd as a guide to useful adjustments in his selection criterion. Whatever the initial criterion, if close observation of performance indicates undesirable trends in one or more important aspects of phenotype, provisional adjustment in the selection criterion is obviously in order until still further observation indicates a need for other adjustments. By this I do not mean to imply we should abandon efforts to predict most effective selection criteria (indexes). What I do wish to convey is the opinion that our predictions will usually be something less than perfect and that frequently perhaps the best basis for effective modification of a selection criterion will be careful observation of what happens when it is used.

HERITABILITY AND ECONOMIC IMPORTANCE OF CHARACTERS THAT SHOULD BE INCLUDED IN A BEEF CATTLE SELECTION INDEX--BEST CURRENT ESTIMATES

Connell J. Brown and Warren Gifford

The potential value and need of a selection index to be used as a criterion for choosing or rejecting individual beef animals for the breeding herd has long been recognized by the writers. However, a specific or permanent index has not been adopted for the Arkansas Station herd and an index for rating young sires has only been used for a period of two years.

Previous discussion has emphasized the importance of estimates of heritability and economic value for each trait included in a selection index.

Estimates of heritability for a number of traits that may have economic significance have been made during the past decade. They are included in Table 1. It may be of interest to list them according to their application to the various beef production programs. (Slide)

It is evident that the estimates of heritability on many of the traits that should be included in a general index are not available. Further more, specific values that can be assigned to the economic traits are less available. For instance, Stewart (2) reports a 10% price difference between grades on steers. Hazel (1) has suggested some values for weaning weight, weaning score, feed efficiency and rate of gain. There are a few other values available.

From the practical application viewpoint, we have delayed the adoption of a general index because we lacked the information to formulate an index that would include many of the essential economic traits, with each treated with proper emphasis.

In order to be fashionable and to make some attempt to aid local commercial cattle growers in selecting the young performance-tested bulls that were to be sold at the Performance Tested Sire auction, we adopted the simple index which included only four characteristics. The traits were: 120 day weight, classification score, gain per day and feed per pound gain.

$$\text{Index} = 75 + \frac{10}{4} \sum \frac{X_i - \bar{X}_i}{s_i}$$

This allows equal credit to all four traits if they were independent. The best estimates of heritabilities of these traits indicate that in most herds they would be expected to fall in the medium range. The economic values most likely would be different on different farms. We do not have suitable estimates of their values.

To be specific, we still need methods or factors that will adjust for such changes in values that have occured since our meeting at Front Royal when we saw calves sell at 45 cents per pound and today they might sell for 25. What are the values to be assigned in the index to such factors as fertility, longevity, disposition, regularity of production, ability to gain on roughage and pasture, or some of the demerits like prolapse of the vagina, large teats and ill-shaped udders, sterility in young heifers, cancer eye or dwarfism.

How to use the merits or defects of direct and collateral relatives: For example, shall we include dwarfism in the index or will we select against the dwarf gene independently of other traits?

Again, to find a between-sire difference for carcass grade would be exciting, but what should be the economic value in the index when the sires are producing calves for the calf wintering or yearling grazing program as compared with the fat calf or baby beef programs.

The heritabilities and values of the economic importance are needed for these and many other traits.

(1) Hazel. 1952 Report to NC-1.

(2) Stewart. Department of Animal Industry, North Carolina Report 15.

TABLE 1. HERITABILITY ESTIMATES OF SOME ECONOMIC TRAITS IN BEEF CATTLE

Est. %	No.		Method	Reference
			Birth Weight	
23	19	Sires	1	1
34	20	"	3	1
45	6	"	1	3
100	6	"	1	3
53	110	"	1	4
72	88	"	1	5
35	137	"	1	6
44	1,231	Dams	2	7
35	85	Sires	3	7
50	9	"	1	14
22	-		2	15
25	139	Dams	2	19
28	19	Sires	1	19
			Birth to Weaning Gain	
0	6	Sires	1	3
45	6	"	1	3
21	137	"	1	6
7	1,231	Dams	2	7
17	85	Sires	3	7
			Weaning Weight	
12	19	Sires	1	1
30	20	"	3	1
26	6	"	1	3
52	6	"	1	3
28	110	"	1	4
23	88	"	1	5
24	137	"	1	6
11	1,231	Dams	2	7
25	85	Sires	3	7
0	--		1 & 3	15
5-15	--		2	15
100	19	"	1	18
37	19		1	19
43	19		1	19
3	19		1	19
-6	--		2	20
			Weaning Score or Grade	
28	86	Sires	1	4
18	124	"	1	6
16	1,231	Dams	2	7
15	77	Sires	3	7
53	19	"	1	2
0	20	"	3	2
49	5	yr. av.	Direct	9
57	5	yr. av.	Direct	9
31	83	Sires	1	11
30	715	Dams	2	17
50	15	Sires	1	17
23	1,257	Dams	2	17
24	89	Sires	1	17
26	--		2	20

Est. %	No.		Method	Reference
			Yearling Weight	
47	137	Sires	1	6
43	1,231	Dams	2	7
17	243	"	2	10
39	243	"	4	10
16	11	Sires	1	19
37	-		2	20
			Gain, Wean to Yearling	
39	137	Sires	1	6
18	1,231	Dams	2	7
24	- -		2	20
			Yearling Score	
27	124	Sires	1	6
14	1,231	Dams	2	7
20	--		Direct	9
63	--		Direct	9
63	--		2	20
			Growth Rate or Feed Lot Gain	
99	19	Sires	1	1
97	20	"	3	1
65	110	"	1	4
60	88	"	1	5
31	5	yr. av.	Direct	9
21	5	yr. av.	Direct	9
70	83	Sires	1	11
33-51	95	"	-	12
54	73	Prs.	5	12
100 +	--		1	13
19	9	Sires	1	14
29	11	"	1	19
			Efficiency	
75	19	Sires	1	1
48	20	"	3	1
22	88	"	1	5
3	9	"	1	14
			Final Feed Lot Weight	
81	17	Sires	1	1
94	20	"	3	1
86	110	"	1	4
92	72	"	3	4
84	88	"	1	5

Est. %	No.		Method	Reference
			Slaughter Grade	
63	19	Sires	1	2
45	104	"	1	4
42	88	"	1	5
9	--		-	8
58	9	"	1	14
			Carcass Grade	
84	19	Sires	1	2
33	104	"	1	4
16	88	"	1	5
68	9	"	1	14

Est. %	No.		Method	Reference
			Area of Eye	
69	19	Sires	1	2
68	64	"	1	4
72	88	"	1	5
			Dressing Per Cent	
73	88	Sires	1	5
69	9	"	1	14

	Est. %	No.		Method	Reference
First winter gain	99	19	Sires	1	18
Summer gain	15	--		1	18
Fall gain	15	--		1	18
Second winter gain	83	--		1	18
Thickness of fat	38	88	Sires	1	5
Color of Eye Muscle	31	88	"	1	5
Days to weaning	45	9	"	1	14
Days to final weight	57	9	"	1	14
Weaning weight of daughters' calves	19	--		1	15
Shrink	91	88	"	1	5
Yearling gain	24	--		2	20

METHOD OF ESTIMATION

Ref. No.	
1	Paternal Half-Sib
2	Regression of Offspring on Dam
3	Regression of Offspring on Sires
4	Paper Selection
5	Regression of Offspring on Parent

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A SIMPLE INDEX FOR FARM USE

T. J. Marlowe and C. M. Kincaid

In any kind of a livestock breeding program ine is interested in selecting for certain traits. These traits usually vary in importance and thereby in the amount of selection pressure used for each. You have just herd a most interesting discussion by Dr. E. J. Warwick on the "Amount of Selection Possible in Beef Cattle". You are now aware that as the number of traits increases the selection pressure for each rapidly decreases.

In our Beef Cattle Improvement Program in Virginia we are interested in the following traits:

1. Rapid growth rate
2. Desirable type and conformation
3. Regular reproduction
4. Milking and mothering ability
5. Longevity
6. Carcass quality

Even though all of these traits are important, to try to incorporate all of them into an index would complicate it unnecessarily. Furthermore, some of these traits cannot be evaluated in a single year. Therefore, we have decided on a very simple index which concentrates our selection efforts on only the first two traits mentioned, rapid growth rate and desirable type. Indirectly this index also selects for each of the other traits. For example, the calf with the fastest growth rate from birth to weaning will most likely have a good milking mother.

We are interested in retaining the excellent type that we have in many of our herds and improving it in the herds of lesser desirable type. Therefore, we have given equal weight to type and growth rate in our index.

Lets see now just how the index was constructed. (Dr. Kincaid should be presenting this part since he is the father of the index that we are presently using.)

Units of Variation:

(a) A study of daily gains from birth to weaning in our station herds showed that approximately 2/3 of the calves belonging to the same herd were within 1/4 of a pound per day of the average. This means that for a group of calves with an average daily gain of 1.70 pounds, about 2/3 of them would be between 1.45 and 1.95 while 1/6 would be below 1.45 and 1/6 above 1.95. From this, he got 1/4 of a pound per day as the unit of variation when he converted to an index.

(b) The unit of variation for grade turned out to be about 2 grade points. With a group averaging 10.5, one would expect 2/3 to be between 8.5 and 12.5 with 1/6 below 8.5 and 1/6 above 12.5.

Index Values:

To give daily gain and grade the same emphasis, it was necessary to make a unit of variation in each having the same value. This was done by making 1/4 of a pound per day worth 10 and 2/3 of a grade (2 grade points) worth 10. Since steer calves in the research program showed average daily gains of 1.70 and average grades of a little over 10, he took these as the

average or base values and made a calf with these values equal 100. This gave the average calf 50 for gain and 50 for type. To speed up the calculations formulas were obtained for gain and grade as follows:

Index for gain = 40 X adj. daily gain - 18
Index for grade = 5 X grade

For the average calf above we get
Index for gain = 40 X 1.70 - 18 = 68 - 18 = 50
Index for grade = 5 X 10 = 50

Total index = 50 + 50 = 100

To make comparisons of weanling index values meaningful it was necessary to make certain adjustments in the growth rate of calves from cows of different ages and calves of different sexes. Therefore, adjustments were made to a mature cow basis and to the equivalent growth rate of steer calves.

Average daily gain from birth to weaning of calves in the research herd in Virginia showed daily gains and factors needed to adjust to steer calves from mature cows as follows:

	Cows with first calf			Cows that had produced one or more calves		
	Heifers	Steers	Bulls	Heifers	Steers	Bulls
Daily Gain	1.50	1.57	1.60	1.62	1.70	1.75
Correction Factor	1.13	1.08	1.05	1.05	1.00	.97

These correction factors have been used to date to adjust calves for sex and age of dam in our performance testing program. Results up to now in our B.C.I.A. program indicate that the sex adjustments are satisfactory. It appears that we may need to adjust for second calves and also for calves from cows 10 years old or older. We plan to make a detailed study this winter of the index values on some 4,000 calves in the program to see what, if any, adjustments should be made in our correction factors.

In order to make these index values more meaningful to you we have attached a copy of the values obtained from a commercial herd of approximately 100 Hereford cows, in which three sires were used, for your information.

GENETIC CORRELATIONS

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Definition:

Present day usage of the term stems from Hazel (1943) where a genetic correlation was defined as one between the additive genetic values (sums of the average effects of genes) for two traits measured on the same individual. Hazel's genetic correlation implies a narrow sense analogous to the narrow definition of heritability in that it involves only additive effects of genes. It is this sense that is most useful where mates are paired at random because dominance and, for the most part, epistatic deviations are not passed on to the offspring.

Methods of estimation:

As with heritability genetic correlations are estimated by relationships (covariances, correlations or regressions) among relatives. The most common and probably the most useful sets of relatives in beef cattle are parent and offspring and half sibs.

The method for half sibs given by Hazel et al. (1943) is of the following form:

$$r_g = \frac{\text{Cov } s_1 s_2'}{\sqrt{\text{Cov } s_1 s_1' \text{ Cov } s_2 s_2'}} \qquad (1)$$

where Cov is a covariance between one half sib, s, and the other half sib, s'. The subscripts, one and two, designate the two traits. These covariances are estimated as components from analyses of variance and covariance (see Hazel et al., 1943).

The method using parent and offspring, and given by Hazel (1943), is:

$$r_g = \sqrt{\frac{b_{O_1P_2}\ b_{O_2P_1}}{b_{O_1P_1}\ b_{O_2P_2}}} \qquad (2)$$

where b's are regression coefficients, O's indicate offspring and p's indicate parents. Regression coefficients are used because they do not change with selection of the parents provided the relationship between parent and offspring is linear. In any case, the above form reduces the following function of the covariances:

$$r_g = \sqrt{\frac{\text{Cov}_{O_1P_2}\ \text{Cov}_{O_2P_1}}{\text{Cov}_{O_1P_1}\ \text{Cov}_{O_2P_2}}}$$

A variant of this method, and using the same covariances is:

$$r_g = \frac{\text{Cov}_{O_1P_2} + \text{Cov}_{O_2P_1}}{2\sqrt{\text{Cov}_{O_1P_1}\ \text{Cov}_{O_2P_2}}} \qquad (2a)$$

This variant is often used when the two covariances in the numerator differ in sign. However, for traits which are maternally influenced these covariances are estimating different things.

Genetic correlations between maternal and individual influences were considered by Dickerson (1947) including some theoretical development. A more thorough consideration, and in beef cattle, was made by Koch (1953) (Published in part by Koch and Clark, 1955). As an example consider a character which is influenced maternally such as weaning weight or score. Under the simple conditions of only additive effects of genes the covariance between a trait in the sire and the same trait in the offspring is

$$\text{Cov } Ox = \frac{1}{2}\sigma^2_{g_O} + \frac{1}{4} r_{g_O g_m}\, \sigma_{g_O}\, \sigma_{g_m},$$

where $o^2_{g_0}$ is the additive genetic variance for the offspring's own ability, $o^2_{g_m}$ is the additive genetic variance for the maternal ability of the dam and $r_{g_0 g_m}$ is the genetic correlation between the two additive genetic values. The covariance between paternal half sibs is

$$\text{Cov ss} = \frac{1}{4}\sigma^2_{g_0} .$$

If the environment of the dam receives as a calf does not carry over and influence the environment she furnishes her offspring, the covariance between offspring and dam is

$$\text{Cov Od} = \frac{1}{2}\sigma^2_{g_0} + \frac{1}{2}\sigma^2_{g_m} + \frac{5}{4} r_{g_0 g_m} \sigma_{g_0} \sigma_{g_m} .$$

Covariances between full sibs and maternal half sibs have an additional permanent environmental maternal component as well as those listed above. The three unknowns can be solved for in the above three equations but sampling errors would no doubt negate any convictions about the estimates. However, the above covariances serve to illustrate that they are no longer simple multiples of each other, and they may explain, in part, discrepancies among heritabilities estimated by different methods.

Variance of estimates:

Formula for approximating the variance of genetic correlations were derived by Ercanbrack (1952) for method (2) and by Rae (1950) for method (2a), both of which methods involve parent and offspring. Both of these formula are cumbersome and involved and anyone wishing to use them should refer to the original sources. However, for the purpose of indicating the amount of data needed for reliable estimates, they may be simplified considerably. The simplification comes about by assuming that the phenotypic variances are the same in the two generations, that the phenotypic correlations, r_p, between the two traits are the same in the two generations and that the correlation between one trait in the parent and the other trait in the offspring, r_{12}, is the same as the one with the two traits reversed. The other two correlations in the following formula are between the same traits in parent and in the offspring, r_{11} for trait 1 and r_{22} for trait 2, n is the number of offspring parent pairs,

$$V(r_g) = \frac{1}{2nr_{11}r_{22}} \left[2 \left(\frac{r_{11}+r_{22}}{2\sqrt{r_{11}r_{22}}} \; \frac{r_{12}}{\sqrt{r_{11}r_{22}}} - r_p \right)^2 + \left(1 - \frac{r^2_{12}}{r_{11}r_{22}}\right)(1 - r_p^2) + r_{11}r_{22} \left(1 - \frac{r^2_{12}}{r_{11}r_{22}}\right)^2 \right]$$

In more familiar terminology where heritability, h, is taken as twice the offspring parent correlation ($h_1 = 2r_{11}$ and $h_2 = 2r_{22}$) and the genetic correlation as $r_{12}\sqrt{r_{11}r_{22}}$, the above formula becomes

$$V(r_g) = \frac{2}{nh_1h_2} \left[2 \left(\frac{h_1 + h_2}{2\sqrt{h_1h_2}} \; r_g - r_p \right)^2 + (1 - r_g^2)(1 - r_p^2) + h_1h_2 \left(\frac{1 - r_g^2}{2} \right)^2 \right] .$$

Unless the heritabilities differ widely the term $(h_1 + h_2)/2\sqrt{h_1 h_2}$ will be very close to one. As can be seen from the term $2/nh_1h_2$ the variance decreases as heritability increases. The term in the brackets is one when the two correlations, r_g and r_p, are zero. It becomes larger than one and increases as one correlation increases from zero and the other decreases from zero. It becomes less than one and decreases as both correlations simultaneously increase or decrease from zero. Thus the bracketed term varies around one and as a rough thumbrule it can be taken as unity. This approximation gives the following standard deviations, $\sqrt{2/nh^2}$ for $h_1 = h_2$:

	n			
h	100	500	1000	10,000
.1	1.41	.63	.45	.14
.3	.47	.21	.15	.05
.5	.28	.13	.09	.03
.7	.20	.09	.06	.02

It is apparent that many offspring parent pairs are necessary to bracket the genetic correlation within a reasonable range.

While the variance of genetic correlations estimated by the half sib method has not been considered, the standard deviation is for all practical purposes the same for a genetic correlation estimated from 2n sires, each with two half sib progeny, as that given above for n pairs of parent and offspring. The variance decreases as the number of progeny per sire increases but the decrease is not a simple function of the number of progeny per sire.

Effects on progress:

To illustrate the role of genetic correlations in progress from selection we shall consider n traits equally variable, heritable and important. Also they are equally correlated with each other (i.e., r_p is constant and r_g is constant). The total genetic progress from selecting on the basis of a single trait is

$$G_T \text{ from } 1 = k \frac{\sigma_g^2}{\sigma_x} \left[1 + (n - 1)r_g\right]$$

while that from selecting on the basis of an index involving all traits is

$$G_T \text{ from } I = k \frac{\sigma_g^2}{\sigma_x} \left[1 + (n - 1)r_g\right] \sqrt{\frac{n}{1 + (n - 1)r_p}},$$

where k reflects the intensity of selection, σ_g^2 is the additive genetic variance of each trait and σ_x^2 is the phenotypic variance of each trait. While these formula indicate the superiority of the index, they also show that the genetic correlations do the same sort of thing for either method of selection. The common sense result, of course, is that the larger the genetic correlations the greater the progress. Negative ones will hamper the effectiveness of selection and can nullify it.

With respect to the genetic correlations between maternal and individual effects, it is pertinent to point out here that, if the regressions of offspring on sire and on dam are of appreciable size, knowledge of the two genetic variances and the genetic correlation are not of immediate concern. A first approximation to the effects of selection, where mates are selected on their own phenotype and paired at random, is

$$S_x\, b_{0_x} + S_d\, b_{0_d}.$$

S_x and S_d are selection differentials for the sire and dam respectively. Since the greatest selection pressure is among sires, selection advance depends more on b_{0x} than on b_{0d}. It is only when these two regressions are very small that a thorough analysis is necessary to find the causes and possible remedies. Aside from ova transplantation and foster rearing, little else can be done on the dam's side to overcome a negative genetic correlation between maternal and individual effects.

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SOME LIMITATIONS OF SELECTION INDEXES

T. C. Cartwright and Bruce L. Warwick

The term "index" as used in connection with selection of livestock may refer to various procedures of combining data in order to rank certain merits of individuals. The limitations of indexes suggested here reger to the types described by L. N. Hazel (Genetics 28:476-490, 1943). Because of the interests of this S-10 group, this discussion is divided to separately cover the limitations of the use of selection indexes (1) in general (suggested by Hazel mainly), (2) at Bluebonnet Farm and (3) throughout the S-10 region on a uniform basis. Some of the points of each category may apply to subsequent categories.

I. General limitations:

a. The information needed for constructing an index for beef cattle is not all available. The relative economic importance of birth weight, weaning weight, feed lot gain, pasture gain, summer gain, conformation scores

and carcass evaluation and perhaps other characters is scarcely if at all known. This lack of knowledge may encourage undue emphasis on characters of little productive value (such as conformation) which can be dignified by numerical expression in a selection index. The correlations between these characters are also not fully known. Our knowledge of heritability and genetic correlation is, perhaps, even less advanced. Heritability estimates of rate of gain in the feed lot, for example, have been reported which range from nearly 0 to 100 per cent.

b. An index could be expected to be applied with best success only to the herd from which some of the statistics used in its calculation were derived. The genetic constitution of different herds may vary because of previous selection. Phenotypic variance may be different for different herds but this probably would not be serious for herds of the same breed. It would be very serious for different breeds if the differences between the Herefords and Brahmans at Bluebonnet is a good indication.

c. Selection indexes, if computed for each breed or cross, locality and season would not be a valid indication of an individual's merit for comparison purposes or to measure progress.

II. At Bluebonnet Farm:

a. Five pure breeds and 9 different types of crosses of these breeds would necessitate the computation of 14 different selection indexes.

b. The selection emphasis placed on each trait varies with the stage of development of the particular breed or cross.

c. Because of the varied duties and responsibilities of the personnel at the station, it would be difficult to keep all indexes currently accurate for the herd.

d. It is felt that it is much more practical to cull some animals at weaning, others after the gain test and still others after exposure to a period of summer heat. In so doing, feed and facilities that would be necessary to grow animals out at least through the first summer period after the test, can be used to maintain a larger breeding herd and to test more cooperator cattle.

III. Throughout the S-10 Region:

a. Because of differences in feed supply, climate and other conditions, the relative selection pressure varies for each character throughout the region. A single uniform index would not allow area differences to be considered. The emphasis placed on weaning weight would probably vary more than for any other character.

b. A uniform selection index for all stations would tend to decrease individual initiative. Also, the full significance and details of the various characters and their inter-relationships and inter-actions with different environments would tend to be obscured or overlooked.

SELECTION FOR SINGLE ITEMS OF PERFORMANCE

B. L. Southwell

This report is concerned primarily with studies presently under way at the Georgia Coastal Plain Experiment Station. Three herds of approximately 20 cows each have been established to study the effects of selecting for single items of importance, namely, weaned weight, rate of gain in feed lot, and type. An additional herd of approximately 50 cows has been set aside to study the effects of selecting for all three characters simultaneously.

The objectives of this study are: (1) To obtain preliminary information on the relative effectiveness of selecting for a single character and for a number of characters simultaneously, and (2) To observe the trends in characters for which no selection is made when selection is for a single character. This study will be continued for 12 to 15 years or so before definite observations are made.

Selection for several characters would indicate that if progress is made then the characters concerned are independent. Yet, there might be antagonism between characters which would complicate selection. It is considered rather important to make a study which could reveal important information on this subject.

Afternoon Session - September 8, 1955:

Chairman Koger asked the secretary to introduce Mr. David Levy who made a few remarks about Beef Cattle Breeding in Israel. He emphasized the fact that beef was limited in his country and was almost unavailable except at holidays.

Discussions on "Progress in Developing Plans for Crossbreeding Studies with British-type Cattle", were given by W. M. Warren of Alabama, C. M. Kincaid of Virginia and W. C. McCormick of Georgia, dealing in each case with proposed projects at the stations involved. These discussions are not reproduced here but copies of project outlines can be secured from the speakers by interested persons.

BRAHMAN CROSSBREEDING STUDIES

W. C. McCormick and B. L. Southwell

In fulfilling the request to discuss this subject and in looking over available data on Brahman crossbreeding, the decision was made to compare British breeds with Brahman crossbreds for beef production. Records for other part Brahman breeds such as the Santa Gertrudis or Brangus were omitted. It was further decided to use data wherein enough records had been accumulated to warrant some kind of conclusion. This limited this discussion to a comparison of British with the F_1 British X Brahman cross animals and the calf production record of the F_1 female with the British females. The decision was made to study birth and weaned weight (table 1), rate and efficiency of gain in feed lot (table 2), and yield and carcass grade (table 3) in comparing the British with the F_1 Brahman X British animals. Birth and weaned weights of calves (table 4) were used in comparing calf production of the F_1 and British brood cows.

Data have been taken from available publications and from S-10 reports. The source of data is recognized on each table. In general the data have been listed on a within year and location basis. In several cases sexes have been separated.

Data have been taken from reports as listed in an effort to obtain the best comparison.

We can assume that we are dealing with raw, uncorrected data. We hope that numbers of animals in each study are great enough that sex and age of dam differences will average out and that results will be fairly reliable. Birth weights are recorded as reported and in general are not adjusted for sex and age of cow differences. The same is true for weaned weights. Some were adjusted to 180 days, some to 210 days, and others were listed at weaning. Sexes were separated in looking at feed lot data. Year differences have not been accounted for in some of the data. An attempt was made to remove as many variables as possible in making comparisons. In comparing the performance of F_1 females with British females on the results may be biased in favor of British females if mature British cows were used in making the comparison. It seems that all F_1 cows were produced at the various stations and might have been younger animals.

In calculating differences, the comparisons are averaged regardless of numbers in each comparison. They have also been weighted in proportion to numbers in the various comparisons and when materially different results are obtained, the differences are discussed.

It has not been possible to use all Brahman crossing work in this study. Some would not fit the pattern selected for discussion; for some, it was not possible to separate the data so that it could be used, and in other instances the numbers involved in certain crosses were small. In addition to the specific data reported other trends are discussed when sufficient information was available.

The majority of the British cattle used were Herefords, with a lesser number of Angus and a minority of Shorthorns. Most of the work was conducted in the Southeastern region.

Birth and Weaning Weights

For observations on birth weights, records were available for 801 British calves and 1135 F_1 calves. Twenty-one comparisons are listed. The F_1 calves weighed seven pounds, or ten per cent, more at birth than did the British calves. The F_1 calves were heavier than the British calves in all comparisons except two. Thus, it seems that we could state that F_1 calves are heavier at birth.

Records of 805 British and 1148 F_1 calves listed as 25 comparisons were available for weaned weight study. When the comparisons were averaged, there was a difference of 41 pounds weaned weight in favor of the F_1 calves. When the records were weighted in proportion to sample number, there was a difference of thirty pounds in favor of F_1 calves. The F_1 calves were heavier in all comparisons except one and in this case, the numbers in the sample were small. Since the F_1 calves were approximately eight per cent heavier and consistently so in the comparisons, we can be reasonably safe in stating that the F_1's are definitely heavier at weaning.

By using data from S-10 reports for Texas, North and South Carolina, and Georgia, it was noted that 91 per cent of British calves born were weaned (521 born - 473 weaned). For the F_1 calves born, 94 per cent were weaned (775 born - 725 weaned). Thus, it seems that there were either fewer stillborns or better survival ability among the F_1 calves.

Feed Lot Data

The majority of animals fed were calves which were placed on feed shortly after weaning and fed 140 days or more. Some were yearlings. The type rations fed varied from high concentrate to high roughage. Sexes were separated in all comparisons except one.

Records for 663 British and 739 F_1 animals are listed as 32 comparisons for rate of gain. By averaging the comparisons the daily gain computed for the British calves was 1.97 pounds, whereas the daily rate of gain for the F_1 calves was 1.91 pounds. The British calves gained three per cent faster. The F_1 calves also made slower gains in the majority of comparisons. When the gains were weighted according to the numbers per sample, the calculated daily rate of gain was 1.94 and 1.82 pounds, respectively, for the British and F_1 calves. This amounted to 6.5 per cent faster gains for the British calves. It may be noted that in three of the four North Carolina comparisons listed, the F_1 calves gained faster than the British calves. Since the numbers per sample were small in these cases, the latter method of arriving at daily gain is definitely considered more reliable.

Records for 528 British and 601 F_1 calves listed as 23 comparisons were available for studying feed efficiency. The British calves consumed approximately 1017 pounds feed per hundred pounds gain, whereas the F_1 calves required 1130 pounds, or 11 per cent, more feed per 100 pounds gain. This would definitely seem to indicate that the F_1 calves were less efficient and eepecially since the F_1 calves consumed less fed per unit of gain in only three of the comparisons.

Slaughter Data

Slaughter data for calves and yearlings were combined. The South Carolina and last group of Georgia records are for calves killed immediately following weaning. The other animals were listed under feed lot data and on the average were fed reasonably well and for more than 120 days. Carcass grade rather than slaughter grade was selected for grade comparisons since nearly all calves had been assigned a carcass grade and also, it was thought that these comparisons were less biased. All grades were converted to a numerical value of 8-12 for choice, 14-18 for good, and 20-24 for commercial.

Records for 352 British and 394 F_1 calves are listed. Twenty-seven comparisons are shown for yield and 25 for grade. The average yield for the British and F_1 calves was 57.3 and 59.3 per cent, respectively, or a difference of two per cent in favor of the F_1 calves when the comparisons were averaged. When weighted according to numbers per sample, the differences were 2.5 per cent. It is interesting to note that the difference in yield was in favor of the F_1 calves in all except two cases. For these two instances the yield favored British calves by .7 and .2 per cent and in both cases the numbers per sample were small. I believe we can agree that the F_1 calves yield better than the British calves.

The average carcass grade for the British animals was 15.22, or just slightly better than average good, whereas the average grade for the F_1 animals was 16.50, or slightly below average good. The numerical difference was 1.28, or less than one-third of a grade. The difference was only 1.00 when the weighted figure was used. It was interesting to note the slight difference in carcass grade, since it is generally thought that the differences are greater. We may then say that the carcass grades of F_1 calves were slightly lower than those of British breeding.

Other Observations

It was noted in looking through the available data on Brahman crossbreeding that the growth rate of F_1 animals being wintered or pastured was equally as good as for British animals. Likewise, the mature cow weights were equally as high for the F_1 cow as for the British cow. No attempt was made to obtain an estimate of percent calf crop for Brahman crosses as compared to British bred cattle. We feel sure that sufficient information is available at the various stations to furnish a rather reliable answer to the above observations. It seems that the pooling of such data would definitely be worthwhile in obtaining answers to these pertinent questions.

British Versus F_1 Females - Birth and Weaned Weights

Some of the data for British females used in this comparison was also used in Table 1. Records for 581 calves from British cows were available for comparison with 345 calves from F_1 cows in studying birth weights. The birth weights of both groups were essentially the same when averaged or when weighted according to the numbers per sample. Records for 586 calves from British cows were available for comparison with 421 calves from F_1 cows in observing weaning weights. The weaned weight of calves from British cows was approximately 350 pounds, whereas the weaned weights of calves from F_1 cows was approximately 430 pounds. This difference of approximately 23 per cent more weight of calves at weaning seems to be the major advantage of Brahman crossing.

In making this study, records were used wherein the F_1 cows was backcrossed to British bulls. Other records are listed in the table wherein Brahman bulls were backcrossed to F_1 cows, F_1 cows mated to F_1 bulls, and British bulls bred to part Brahman cows. These records also show the superiority of part Brahman cows in reference to weaned weights.

Summary

An attempt has been made to summarize Brahman crossbreeding studies by (1) comparing British with F_1 Brahman X British calves and (2) comparing the performance of the F_1 cow with the British cow. These studies indicate that F_1 calf is approximately seven pounds, or ten per cent, heavier at birth and approximately thirty pounds, or eight per cent, heavier at weaning than the British bred calf. In feed lot studies the British calves gained approximately six per cent faster than the F_1 calves. The F_1 calves required about twelve per cent more feed per unit of gain than did the British calves. The dressing per cent of the F_1 calves was 2.5 per cent greater; however, the carcass grade of the F_1 was somewhat poorer than for the British calves.

Observations tended to indicate that there were either fewer stillborns or better survival ability among F_1 calves. It was also noted that the growth rate of F_1 calves being pastured or wintered was equally as high as for British calves and the F_1 cow was as heavy at maturity as the British cow.

These studies indicated that the F_1 cow or part Brahman cow was superior to the British cow when judged by weaning weights of calves. The F_1 cow weaned calves approximately 23 per cent heavier than did the British cow.

Whether or not the producer crosses his British cattle with Brahman cattle will depend upon the type program he intends to follow. The advantages or disadvantages of Brahman crossing should be considered in reference to the producer's program. The two major advantages in Brahman crossbreeding would be in a slaughter calf program and where emphasis needs to be placed on weaned weight.

Table 1. Birth and Weaning Weights

Source of Data	No. Born		No. Weaned		Birth Weight			Weaned Weight		
	British	F_1	British	F_1	British	F_1	Diff.	British	F_1	Diff.
Texas S-10, 1950	39	116	37	102	77	83	+ 6	371	404	+ 33
" " 1951	54	168	48	164	60	78	+ 18	303	349	+ 46
" " 1952	55	118	50	109	69	76	+ 7	357	385	+ 28
" " 1953	93	118	85	108	70	81	+ 11	349	385	+ 36
" " 1954	68	80	58	76	72	82	+ 10	359	422	+ 63
N. Car. " 1950	9	5	6	5	--	--	—	225	208	- 17
" " 1951	12	13	10	13	--	--	--	222	286	+ 64
" " 1952	12	8	12	7	68	71	+ 3	226	294	+ 68
" " 1953	16	6	15	6	64	63	- 1	294	334	+ 40
" " 1954	15	6	15	6	68	74	+ 6	300	357	+ 57
S. Car. " 1950	23	18	21	15	62	75	+ 13	470	512	+ 42
" " 1951	16	10	14	10	66	72	+ 6	450	481	+ 31
" " 1951	17	14	16	14	66	86	+ 20	476	551	+ 75
" " 1952	20	22	20	20	62	86	+ 24	477	565	+ 88
" " 1952	14	14	14	14	85	76	- 9	483	486	+ 3
" " 1953	9	12	8	12	69	69	—	439	459	+ 20
U.S.D.A. Circ.844	27	56	27	56	56	66	+ 10	293	350	+ 57
" "	11	15	11	15	64	71	+ 7	320	411	+ 91
L.S.U. S-10, 1952	9	10	9	10	61	67	+ 6	363	370	+ 7
" " 1954	11	15	11	15	--	--	—	408	418	+ 10
U.S.D.A. Circ.673	56	55	56	55	75	75	—	316	354	+ 38
" " 673	64	37	64	37	74	83	+ 9	355	390	+ 35
Texas Bul. 409	134	205	134	205	75	75	--	373	383	+ 10
" " 409	20	30	20	30	--	--	--	330	411	+ 81
" " 409	49	47	44	44	66	74	+ 8	463	491	+ 28
Total	853	1198	805	1148	1429	1583	154	9022	10056	1034
Average					68	75	7	361	402	41
Weighted					70	77	7	363	393	30

Table 2. Rate of Gain and Feed Efficiency in Feed Lot

Source of Data	Sex	No. Calves Fed		Rate of Gain			Feed Per CWT. Gain		
		British	F_1	British	F_1	Diff.	British	F_1	Diff.
Texas S-10, 1954	S	9	10	2.2	2.1	- .1	---	---	-----
" " "	S	9	10	2.2	2.1	- .1	---	---	-----
" " "	B	10	9	2.4	2.7	+ .3	793	818	+ 25
" " "	S	32	35	2.1	2.1	0	859	940	+ 81
" " "	S	15	15	2.2	2.0	- .2	880	997	+ 117
" " "	H	38	50	1.8	1.8	0	968	971	+ 3
" " 1953	S	18	12	1.88	1.81	- .07	959	953	- 6
" " "	B	32	9	2.20	2.20	0	904	968	+ 64
" " "	S	34	23	1.90	1.50	- .30	923	1250	+ 327
" " "	S	8	20	2.10	1.70	- .40	846	1069	+ 223
" " "	H	49	57	1.70	1.50	- .20	1042	1114	+ 72
" " 1952	B	38	21	2.20	2.40	+ .20	926	996	+ 70
" " "	S	11	22	1.80	1.70	- .10	1045	1190	+ 145
" " "	H	27	78	1.60	1.50	- .10	1102	1299	+ 197
" " "	S	11	41	2.00	2.10	+ .10	1001	940	- 61
" " 1951	S	19	54	2.20	2.30	+ .10	---	---	-----
" " "	H	34	16	1.80	1.70	- .10	---	---	-----
N. C. " 1954	S	12	12	2.10	2.00	- .10	905	894	- 11
" " 1946	S	12	3	1.93	2.14	+ .21	---	---	-----
" " 1947	S	10	6	1.97	2.27	+ .30	---	---	-----
" " 1948	S	13	6	1.82	2.28	+ .46	---	---	-----
Ore. Bul. 549	H	5	6	2.31	2.27	- .04	1081	1088	+ 7
" " 549	S	18	18	2.43	2.18	- .25	1043	1189	+ 146
Cal. J.A.S.14:218,1955	S&H	28	28	2.16	1.90	- .26	843	929	+ 86
Ga. S-10 --	S	18	17	2.52	2.22	- .30	---	---	-----
Ga. " --	H	24	19	1.84	1.68	- .16	858	872	+ 14
U.S.D.A. Circ. 644	S	11	20	1.19	1.28	+ .09	---	---	-----
Texas(U.S.D.A. 417	S	25	24	1.69	1.57	- .12	1275	1452	+ 177
" Tech.Bul.)417	S	25	25	1.68	1.38	- .30	1351	1829	+ 478
" 417	S	19	24	2.13	1.88	- .25	785	1082	+ 297
" 417	S	24	24	1.52	1.49	- .03	1499	1527	+ 28
" 417	S	25	25	1.57	1.53	- .04	1511	1618	+ 107
Total		663	739	63.14	61.28	-17.6	23399	25985	+2586
Average				1.97	1.91	- .06	1017	1130	112
Weighted				1.94	1.82	- .12	1026	1154	128

Table 3. Slaughter Data - Yield and Grade

Source of Data	No. Killed		Yield			Grade		
	British	F_1	British	F_1	Diff.	British	F_1	Diff.
Texas S-10, 1954	9	10	60.3	63.0	+ 2.7	12.5	14.0	+ 1.5
" " "	9	10	59.6	62.9	+ 3.3	14.0	14.5	+ .5
" " 1953	8	16	59.7	61.6	+ 1.9	15.0	21.5	+ 6.5
" " 1952	11	14	57.0	60.4	+ 3.4	12.7	11.9	- .8
" " "	11	14	61.6	63.3	+ 1.7	10.0	11.4	+ 1.4
" " 1951	19	54	61.8	64.3	+ 2.5	11.8	12.7	+ .9
N. C. " --	12	12	58.2	58.8	+ .6	16.0	20.0	+ 4.0
" " --	12	3	57.9	60.5	+ 2.6	13.0	15.3	+ 2.3
" " --	10	6	58.3	58.4	+ .1	12.8	16.3	+ 3.5
" " --	13	6	56.5	61.0	+ 4.5	13.9	13.7	- .2
S. C. " 1950	15	12	58.0	58.8	+ .8	17.5	17.0	- .5
" " 1951	4	5	57.1	56.4	- .7	18.3	18.4	+ .1
" " "	5	5	58.0	59.8	+ 1.8	13.7	13.8	+ .1
" " 1952	9	9	58.7	59.2	+ .5	14.4	14.4	0.0
" " "	8	6	55.2	58.2	+ 3.0	16.4	15.3	- 1.1
" " 1953	5	4	53.0	52.8	- .2	18.0	18.0	0.0
U.S.D.A. Circ. 644	11	20	52.7	54.7	+ 2.0	16.7	18.9	+ 2.2
Oregon Bul. 549	5	6	55.5	55.8	+ .3	12.0	16.0	+ 4.0
" " 549	18	18	57.0	58.8	+ 1.8	12.3	14.7	+ 2.4
Georgia S-10 --	18	17	56.0	58.6	+ 2.6	20.0	20.0	0.0
" " --	22	22	55.9	57.3	+ 1.4	13.0	16.0	+ 3.0
Texas (U.S.D.A.417	17	16	55.8	58.3	+ 2.5	--	--	--
" Tech.Bul)417	16	16	55.9	60.2	+ 4.3	--	--	--
" 417	10	16	56.7	57.7	+ 1.0	17.0	17.0	0.0
" 417	24	24	56.3	58.5	+ 2.2	22.0	22.0	0.0
" 417	25	25	54.9	58.8	+ 3.9	22.0	22.0	0.0
Cal. JAS	26	28	60.4	62.6	+ 2.2	15.6	18.0	+ 2.4
Total	352	394	154.8	1600.7		380.6	412.8	
Average			57.3	59.3		15.2	16.5	
Weighted			57.4	59.95		15.7	16.7	

Table 4. Birth and Weaned Weights of Calves Produced by F_1 and British Females

Source of Data	No. Born		No. Weaned		Birth Weight			Weaned Weight		
	British	F_1	British	F_1	British	F_1	Diff.	British	F_1	Diff.
Texas S-10, 1952	55	4	50	4	69	67	- 2	357	359	+ 2
" " 1953	93	32	85	30	70	70	0	349	402	+ 53
" "	--	--	--	29*	--	73	--	---	401e	—
" " 1954	68	26	58	26	72	69	- 3	359	428	+ 69
" "	--	--	--	20*	--	--	--	---	420e	--
U.S.D.A.Circ.844	27	56	27	54	56	62	+ 6	293	392	+ 99
" " "	—	--	--	21*	--	62	—	---	375a	—
" " "	--	--	—	50*	--	61	—	---	356b	--
" " "	—	--	—	48*	--	64	--	---	378c	--
U.S.D.A.Circ.673	56	59	56	59	75	76	+ 1	316	402	+ 86
" " "	60	11	60	11	69	78	+ 9	333	435	+102
Texas Bul. 409	134	105	134	105	75	69	- 6	373	449	+ 76
" Lufkin	20	21	20	21	—	--	--	330	465	+135
" "	--	—	—	14*	--	--	--	---	447d	—
La. Bul. 244	8	59	8	59	—	--	--	363	496	+ 33
" " "	--	--	--	28*	--	--	--	---	459d	--
Ga.	29	29	29	29	61	65	+ 4	380	455	+ 75
"	43	12	49	12	69	56	- 13	370	430	+ 60
L.S.U. S-10	10	11	10	11	63	62	- 1	340	383	+ 43
Total	609	425	586	421	679	674		4163	5096	
Average					68	68		347	425	
Weighted					70	68		352	435	

*These are not included in averages. They can be compared with the record of British animals immediately above.

a. F_1 X F_1
b. $\frac{1}{4}$B X $\frac{1}{4}$B
c. $\frac{1}{4}$B X $\frac{1}{2}$B and reciprocal cross
d. H X $\frac{1}{4}$B
e. B X F_1

ATTEMPTS TO SYNCHRONIZE ESTROUS CYCLES IN BEEF CATTLE

L. C. Ulberg
Mississippi Agricultural Experiment Stations

There is a marked increase in interest for controlled heat periods in livestock with the use of the hormone progesterone. The objectives are two-fold: (1) to better understand the process which controls the reproductive mechanism, and (2) to develop a technique which will allow for the insemination of cows at a pre-determined date.

During the past 2 years the Mississippi Agricultural Experiment Station has studied the effect of progesterone injections upon about 150 different animals. A total of 137 females have received 14 daily injections of 25 or 50 mg. of the material per day. Of this group 114 individuals (83%) were in estrus 3.0 - 9.5 days after the last injection. The variation in the time of onset of heat increased as the variation in kind of animals used was increased. No explanation is known for this variation.

The rate of diagnosed pregnancies from breedings during the first post-treatment heat is usually very low (21%). This is followed by a near normal conception rate from breedings during second post-treatment heat (56%). The lower dosage results in a higher conception rate, but more variation in the time of onset of heat. Also the heavier animals (or fatter animals?) have a higher conception rate.

Preliminary results indicate that an injection of estradiol benzoate after progesterone treatment will cause a more accurate predicted time of estrus. It has not been established what effect this treatment combination has on subsequent embryonic development.

RESEARCH ON DWARFISM AT THE FLORIDA AGRICULTURAL EXPERIMENT STATION

Marvin Koger

Research program includes three phases at the present time. They consist of: (1) maintaining breeding herds of dwarf cattle, (2) compairsons of various anatomical characteristic of dwarfs and normal cattle, and (3) hormonal treatment of virgin dwarf heifers.

In the first phase dwarfs of Angus, Hereford, Shorthorn, Brahman and various combinations of English and Brahman breeding have been collected and placed in three breeding herds. Bulls used in the herds are "Snorter" Hereford, "Longheaded" Hereford and "Midget" Brahman, respectively. Females used in each breeding herd are of the following types; (1) "Snorter" Hereford, (2) Angus, apparently the same as "Snorter" Herefords, (3) "Long-headed" Angus, (4) "Long-headed" Herefords, (5) "Long-headed" Shorthorn, and (6) "Midget" Brahman.

Fertile matings, determined by manual palpation, this year are;

"Snorter" Hereford	X	"Snorter" Angus
"Midget" Brahman	X	"Midget" Brahman
"Midget" Brahman	X	"Long-headed" Angus
"Long-headed" Hereford	X	"Long-headed" Angus
"Long-headed" Hereford	X	"Snorter" Hereford

In the second phase which is the comparison of anatomical characteristics of various dwarf and normal cattle, the animals considered to be dwarfs were sacrificed and comparisons were made with apparently normal controls.

Animals which were dead at birth or died shortly after birth have been included in this study.

Hormonal treatment of virgin heifers, has been conducted this year. Five virgin heifers were injected intravenously with 5 cc. of pituitary gonadtropin equivalent of 10 rat units or 20,000 I.U. Of the five heifers injected one came into heat and ovulated, two ovulated but showed no heat. The remaining two showed no response.

An Electro-ejaculation machine has been obtained and future plans are to inject dwarf heifers and force breed if they do not come into heat. Sperm from dwarf bulls will be used in making other matings also since by this technique matings can be made which could not be effected by natural service.

MINUTES

Business Meeting
September 8,1955

Chairman, Dr. Marvin Koger, called the meeting to order. Dr. J. O. Grandstaff of OES was introduced. He mentioned that a sizeable increase had been made in federal appropriations for both 1954 and 1955. Dr. W. E. Shaklee and Dr. Ray Ely have been added to the staff to assist with project appraisal and as the OES contact with state experiment station workers. The Animal Science staff of OES now includes two veterinarians -- Drs. Gray and Thompson; Dr. Espe, Dairy Husbandry; Dr. Shaklee, Poultry Husbandry and Animal Breeding; Dr. Ely, Nutrition and Dr. Grandstaff, Animal Husbandry. With this increase in personnel better service should be possible than in the past.

A summary of current research supported by federal grant funds is in preparation. It is hoped that this summary will be useful to research workers in that it will include projects active in their field of interest. The summary will contain objectives, personnel, department and project number and regional participation. Criticisms or ideas on such a summary were solicited.

In addition to the new staff members a number of changes have been made in positions in OES. Dr. Shaklee will be office representative on beef cattle breeding projects S-10, NC-1 and W-1. Dr. Ely will represent regional projects in nutrition. The western region has a project on nutrition of range livestock.

Dr. Grandstaff thanked the S-10 Committee members for courtesies extended him during the past three years. He mentioned the enthusiasm of the group and the progress apparent during his association with S-10. It indicates that the project is progressing well.

Financial support for S-10 has increased indicating an increase in interest of the directors of the region. Total support for this project for fiscal year 1954-55 was $267,000, about one-third of which was from federal-grant funds and two-thirds non-federal. Dr. Grandstaff predicted that increases in 9b3 funds for this project would probably be difficult to obtain in the future. Therefore,

where additional funds are needed non-federal funds will probably be the primary source. The 9b3 funds have increased rather steadily -- 1954, $32,000; 1955, $48,000 and 1956, $69,000.

He indicated that contributing projects are not being revised at regular intervals. Although the regional project was rewritten in 1952 this was not considered a revision. He suggested that a revision for both the original project and contributing projects should be considered.

Dr. Grandstaff indicated that he would like information that would help him to meet the questions of the Committee on Appropriations on the use of funds. He requested that progress reports include results. Copies of any publications should be sent immediately to OES.

Titles have caused some concern. He suggested that all titles for new projects be considered carefully to insure that they state the real purpose of the project. He indicated that titles poorly selected may be misleading to a person not informed on the subject and lead to the thought that there may be duplication and waste of funds. Although committee members know this is not true the OES has in some cases in the past had to convince the House and Senate Committee that it is not true.

The S-10 committee was complimented on the fine program this year. Dr. Grandstaff indicated that it appeared that much effort had been put into the programs and that he felt that there was great advantage in working out the common problems of the project.

Chairman Koger thanked Dr. Grandstaff and invited him to visit with the S-10 committee at any time convenient to him. He commented on the absence of Dr. R. E. Patterson, the Regional Adviser of S-10. In his absence Dr. E. J. Warwick was requested to make any comments he wished.

Dr. Warwick reported that Dr. Patterson in a long distance telephone call had expressed regret for his absence at the meeting.

Dr. Warwick commented that the beef cattle industry is showing increased interest in applying procedures developed from the work of this and the other beef cattle breeding projects. There has been an increase in the publication of popular articles on performance testing. He felt this was evidence that we are gaining respectability.

Concrete evidence of this is available in the recent actions of two breeder groups. Last January a group of breeders from the Panhandle Section of Texas formed a Beef Cattle Performance Testing Association. They are now in the process of drawing up working plans and standards. This job is nearly completed. It is believed that this group is approaching the problem objectively. They are following a pattern similar to the Virginia program and other extension programs that have been developed in other states. They are considering weights of calves at a standard age and other measures of superior performance. They hope to develop into a national organization. Late last spring a group of Virginians organized to carry on performance testing in the state. This group has also entertained ideas of expanding beyond state boundaries. If these and other organized groups work together, we may be able to get some standardized performance testing procedures adopted. Some of the S-10 members have assisted in

guiding the establishment of standards and procedures for both groups. These standards are based on results from research herds. It is believed that the research herds should represent a reasonable cross section of purebred beef cattle under above average management and that data from them should be a fair guide to what can be expected in performance of present-day beef cattle.

Mr. B. L. Southwell expressed appreciation of the S-10 Committee to Dr. Grandstaff for his efforts with the committee. He mentioned that we have been most fortunate to have Dr. Grandstaff with us.

Minutes of the last meeting have been in the hands of committeemen for some time. There were no corrections or comments, therefore, it was assumed they are correct.

In the absence of Dr. C. S. Hobbs, Dr. B. L. Warwick presented the committee report on "Cooperative Analyses of S-10 Data". The Committee reports had been mimeographed and placed in the hands of Committee Members prior to the meeting.

In considering the data on Brahman crossbreds the possibility of a regional publication was discussed. Dr. E. J. Warwick indicated that the regional publication sponsored by Arkansas was cleared informally with each station. Each director approved the publication without assigning a station number. Each station indicated that it would bear its proportional share of reprint cost. He suggested that the S-10 group could recommend that a similar publication on Brahman crossbreds be published as a U.S.D.A. bulletin. Dr. Grandstaff indicated there should be no difficulty in having this material printed as a bulletin of U.S.D.A.

A motion was made by Kincaid and seconded by Damon that a bulletin summarizing work on crossbreeding Brahman cattle be published. The motion carried.

Chairman Koger requested suggestions on procedure in initiating the preparation of this bulletin. Southwell suggested that the disposition of this publication be left to the Executive Committee and to the Regional Coordinator. This motion was made by Dr. Damon and seconded by Dr. Godley. The motion carried.

Dr. E. J. Warwick reminded the group that the new officers take their positions January 1, 1956. This will leave the responsibility for the publication of the cross breeding work on the present Executive Committee.

Item 2 of Committee Report - Reproductive Data. Some discussion of pooling data on reproductive performance data in various station herds. Southwell, Gifford and Koger contributed to this discussion. It was suggested that each station continue to collect information on reproductive performance, but no suggestions were made for pooling data or the analysis of the pooled data. No action was taken.

Item 3 of Committee Report - Adjustment Factors. No action was taken on this recommendation. It was suggested that this portion of the report would be accepted with the acceptance of the report as a whole.

Item 4 - Influence of Sires on Growth Rate of Calves. Dr. Damon moved and Green seconded motion that the Regional Coordinator investigate the heritability of calf weights at weaning and take steps to have a cooperative analysis made if the volume of material available appears to justify it. The motion carried.

Item 5 - Influence of Sires on Maternal Qualities of Daughters. Dr. Smith of Tennessee doubted that many stations had information on this subject. No action.

Items 6, 7, 8 and 9 were not discussed.

Mr. Southwell moved that the report of the committee be accepted as amended and included as a part of the minutes. Motion was seconded by Damon and carried.

Dr. C. M. Kincaid made the motion and Southwell seconded it that the report on record of performance procedures be accepted and made a part of the minutes. Motion carried.

Dr. Kincaid made a plea for wider use of I.B.M. equipment in handling data.

Dr. Gifford, chairman of the Resolutions Committee, read the following report of this committee. This report was accepted unanimously.

REPORT OF RESOLUTIONS COMMITTEE

Be it resolved that the members of the S-10 Technical Committee express their sincere appreciation to Dr. E. J. Warwick for the excellent work he has done for the Southern Regional Beef Cattle Project in general and the help he has given each member in particular. His guidance of the affairs of S-10 has been wise, sincere and without favoritism. As a result S-10 has functioned with little or no internal dissention and has been most effective in carrying out its objectives. Dr. Warwick has been an inspiration to those with whom he has worked. The S-10 Committee members are proud of his advancement to the head of Beef Cattle Research of A.P.H. and feel that the Southern Region will always be considered in all phases of the U.S.D.A. Beef Cattle Program. We feel that in his new position Dr. Warwick can and will better serve the broad policies of the beef cattle industry in the south. We congratulate the officials of the Animal and Poultry Husbandry Branch of A.R.S. in selecting Dr. E. J. Warwick to head up its beef cattle work.

Be it further resolved that the Secretary of the S-10 Committee send a copy of this resolution to Dr. Warwick and a copy to the Chief of the Animal and Poultry Husbandry Branch of A.R.S.

Be it resolved that the S-10 Technical Committee and other co-workers attending the conference express our appreciation to Dr. Stewart, Dean Colvard, Dr. Dillard and their co-workers for the cordiality and hospitality in making our stay on the North Carolina State Campus so comfortable and pleasant. The committee is especially indebted to Dr. Stewart for his arrangements for the spacious and comfortable rooms for meetings and also hotel reservations.

Be it further resolved that this expression of appreciation be made known by a standing vote and further by requesting the secretary to express our thanks by writing the above listed men.

W. W. Green
B. L. Southwell
Warren Gifford, Chairman

Chairman Koger requested that a meeting place be selected for next year. Dr. Green suggested that the committee accept the invitation to the Texas committee member and that the Technical Committee meeting be incorporated with a series of discussions on I.B.M. machines and statistical procedures. Southwell moved and Gifford seconded the motion that the Executive Committee decide upon the meeting place after some consideration. Motion carried. Texas, Georgia and Arkansas have issued invitations.

Dr. Harvey indicated that a workshop would require from five to eight days. The chairman asked for suggestions on the time for the next meeting. Southwell suggested that the time of the 1955 meeting was satisfactory and Dr. Gifford suggested any time between spring and fall semesters. No action was taken. It is assumed that the Executive Committee will set the time of the 1956 meeting.

Dr. Gifford was elected as the New Executive Committee member after the usual nomination and election procedures.

With no further business the meeting adjourned.

Bruce L. Warwick, Secretary

REPORT OF COMMITTEE ON RECORD OF PERFORMANCE PROCEDURES

The material in this report presented as a basis for discussion and possible action by the Technical Committee for the improvement and in so far as practical adapting procedures that may be used by all or the majority of stations. Wider use for I.B.M. equipment points up the importance of having data that can be combined for study of masses of data relating to regional problems. It is hoped that each member of the Technical Committee will give the recommendations set forth below careful consideration and be prepared for a discussion of them.

1. Comparison of Contemporaries:

There are at least four alternatives for comparative testing or contemporary animals, namely:

a. Date constant
b. Weight constant
c. Age constant
d. Fatness or slaughter grade constant

It is recommended that the Technical Committee discuss these alternatives and if it seems practical adopt one or more of them.

2. Individual vs Group Feeding:

Present information indicates that group feeding provides good estimates of efficiency in that the fast gainers are usually the most efficient when weight is constant. Group feeding does not provide data for individual efficiencies, but it does measure each animal under the usual conditions of commercial production. It appears that the best estimates of performance of sire progenies and other groups where group performance is important will be obtained from testing part of each group by individual feeding and part by group feeding. Where the record of all individuals is of primary concern, a design that provides for feeding each individual part of the time in a group and part of the time in an individual stall may give the best estimate of performance.

It is recommended that individual feeding be continued at those stations now doing it and that all stations seriously consider individual feeding for some of the animals tested. It is suggested that stations with the proper facilities consider the possibility of testing the use of short individual feeding periods for the measurement of individual efficiencies of animals fed for the most part in groups.

3. Rations:

As available feeds and production practices vary from state to state, it seems impractical for all stations to have the same standard test rations. It is recommended that all stations obtain chemical analyses for dry matter, crude protein, fat, N.F.E. and fiber on rations or feeds are used.

Pasture is a major feed for beef cattle in the south, but there is little information on its relative value in terms of standard feeds. It is recommended that stations using pasture as part or all of the test feed consider the possibility of paralleling pasture tests with drylot feeding to estimate the real feeding value of the pastures used.

4. Preliminary Test Period:

It is recommended that the S-10 Technical Committee adopt a standard preliminary or pretest period for post weaning performance tests. Four weeks is suggested for this pretest period. If a standard pretest period is adopted it is recommended that gain during the pretest period be included in reports of performance tests so that records are continuous and complete.

5. Method of Feeding:

It is recommended that in so far as possible self feeding be used in all R.O.P. feeding tests. Where hand feeding is practiced each individual should have ample opportunity for maximum feed intake.

6. Weights:

A. Conditions under which weights are taken -

Weights should be taken at a time in a manner that avoids fill from water prior to weighing. Since this committee is not familiar with weighing procedures at the various stations it is recommended that the following procedures be discussed and considered by the S-10 Committee:

a. Early morning weight with animals under usual conditions but before they have had access to water.

b. Withhold feed and water from late afternoon of the preceding day until weights are taken.

c. Weigh at the same time each day with animals having access to feed and water in the usual manner.

B. Initial and final weights -

It is recommended that initial and final weights be based either on the average two or more weights on consecutive days, or on linear regression of weight on time in the first part and the last part of the test, or that gain be computed from the regression of weight on time from all periodic weights during the test period. If a preliminary test period is used, regression on time during the pretest period could be used for initial weights.

7. Grades and Dressing Percentage:

It is recommended that all test animals be graded for type and condition at the beginning and end of each test period. It is suggested that estimates of dressing percentage for each animal at the beginning and end of each test would be useful for estimates of the amount of weight added to the carcass and to the offal.

Carcass grades and dressing percentage should be obtained on all test animals slaughtered.

It is recommended that dressing percentage be calculated from final feed lot weight and hot carcass weight. This will avoid wide variation from shrink enroute to the packing plant and not include the arbitrary uniform shrink by the packer for carcass shrink on chilling.

8. Efficiency of Feed Utilization:

Feed efficiencies should be calculated. This can be done by adjusting for regression of feed intake on weight, or by using feed consumption during periods when weight is the same as the basis for feed intake and average daily gain during the whole as the basis for gain.

Alternative methods of measuring efficiency which should be considered are:

a. Efficiency computed from observed feed intakes and gains.

b. Efficiency computed from feed intakes adjusted for differences in weight or with weight constant and average gain.

Warren Gifford
Charles E. Lindley
C. M. Kincaid, Chairman

REPORT OF THE COMMITTEE ON "COOPERATIVE ANALYSES OF S-10 DATA"

Dr. Marvin Koger appointed this committee on March 7, 1955. Soon thereafter a letter was circulated by the committee chairman to other members of the committee and the regional coordinator raising certain questions regarding data that might best be analyzed on a cooperative basis. The following represents subjects suggested by various persons together with the recommendations of this committee concerning them:

1. Data on Brahman Crossbreds:

All members of the committee are unanimous in recommending an analysis and summary of existing data on this subject as soon as possible. A publication on this could be handled either by a committee of the S-10 Technical group or by the regional coordinator. In either case, everyone in the region having unpublished information would be asked to make it available for the complete summary. The review would, of course, include all published material. It is thought that this material could best be published as a bulletin, either by one of the cooperating stations or the U.S.D.A. In either case it would be definitely identified as a regional publication.

Undertaking a publication of this kind raises certain questions regarding the type of publication, authorship, and the nature of credit to be given cooperating institutions. This committee recommends that each member of the Technical Committee consider this prior to our S-10 meeting and come prepared to take

definite action. This is the first undertaking of this kind for our group and action taken in regard to it may well set a precedent for further presentation on other subjects.

2. Reproductive Data:

It is becoming increasingly apparent that the percentage calf crop in beef cattle breeding research herds is a problem which requires attention. With the limited breeding season most stations are using, calf crops for the region have been averaging in the neighborhood of 80%. The prevalence of every-other-year calving in certain herds where permanent sterility seems to be relatively rare raises the question of how long after calving it is before most beef cows will conceive. Although more intensive data will naturally be needed for any comprehensive study on the problem of reproduction it is believed that a start on elucidating the problem could be made through a study of relation of time after calving to conception in the various herds.

A study of this kind might or might not yield data suitable for publication but would serve as a guide for further research.

It is the recommendation of this committee that all stations in the region make their data on dates of calving, dates of exposure to bulls, etc., on their complete herds for as many years back as possible, available for this study.

Several possibilities for persons who might summarize these data come to mind. Dr. Martin Burris of the Front Royal Station has expressed some interest in the problem, Dr. Alvin Warnick of Florida Station is currently doing the only work in the region on this problem, the regional coordinator might undertake it, or it might be undertaken by a new man being hired by the Animal and Poultry Husbandry Research Branch of the Department of Agriculture to do work in the field of reproductive problems of beef cattle. It is the hope of this committee that the S-10 group will make recommendations at the time of the meeting.

3. Adjustment Factors:

This committee feels that there is a definite need for the use of adjustment factors in all herds if calves of different sexes and from dams of different ages are to be compared at weaning. Some committee members feel that trends are general enough that adjustment factors good enough for routine use in the entire region can be developed and used in much the way that dairymen use adjustment factors. Other committee members feel that so much variation exists in size of adjustment factors needed for different herds that general recommendations cannot be made now or in the future. A review of available information by Smith and Warwick in 1953 (see minutes of 1953 Technical Committee meeting, pages 30 - 34) would seem to support this viewpoint.

It is the recommendation of this committee that each station carefully study the influence of sex and age of dam on calf performance to weaning in their herds during the current year and that a consolidated report be prepared for the 1956 Technical Committee meeting at which time the question can be studied more objectively than is now possible.

4. Influence of Sires on Growth Rates of Calves to Weaning:

Conflicting data have been published regarding the heritability of calf weights at weaning. Several stations in this region have accumulated data in which sires have been bred to equalized or randomly selected groups of cows and all the calves raised to weaning. Although no one station has enough data to be conclusive on this subject it would appear probable that a consolidation of all information from the different stations would give us considerable information on the subject.

It is therefore the recommendation of this committee that the regional coordinator be instructed to look into the extent and availability of such data and take steps to have a cooperative analysis made if the volume of material available would appear to justify this.

5. Influence of Sires on Maternal Qualities of Daughters:

This is one of the very important problems in breeding more productive beef cattle for the South. So far as members of this committee are aware no one station has voluminous enough information to arrive at any conclusions regarding heritability of this important character. It is not known whether enough information is available in the entire region to justify study at this time.

It is the recommendation of this committee, therefore, that the regional coordinator investigate the amount and availability of such data. If it appears to be available in sufficient quantities to justify study he should take steps to initiate analysis.

6. Estimates of Genetic Correlations in Cattle:

This is a problem of vital importance. Most of the discussion of Item 5 will also apply to this item. Recommendations of the committee are the same as for Item 5.

7. Amount and Effectiveness of Selection Being Practiced:

This question is of importance both from a standpoint of studying selection procedures being used and evaluating their apparent effectiveness. For the most part data from closed herds would be most useful for the purpose of this study.

It is recommended that the regional coordinator investigate possibilities of setting up studies on these problems in such a form that results could be incorporated with data which will become available in future years.

8. Effects of Inbreeding on Performance:

Only a few stations are doing work on the problem of inbreeding and numbers are small at any one station.

Within the next few years it would be advisable to combine information available on relation of inbreeding to performance in order to arrive at the best possible estimate of these effects.

9. Index for Beef Cattle:

In regard to developing an index for the region, some members feel there is a definite place for an index while others feel that there might be too much of a tendency to take an index as the final word and that this might have very definite disadvantages. Since there is to be a panel discussion on this subject at the annual Technical Committee meeting, this committee will defer any recommendation regarding analyses of data for the purpose of developing indexes until after that discussion.

Bruce L. Warwick
H. A. Stewart
Charles S. Hobbs, Chairman

Evening Meeting September 9, 1955:

This was a dinner meeting. An illustrated address was given by Dr. H. F. Robinson entitled "Statistical Genetic Studies in Corm and Implications of the Results in Beef Cattle Breeding". (Copy follows).

Two television films were shown: "The Search" showing Texas Beef Cattle Research, and "Beef Cattle Research" at Front Royal, Virginia.

Mr. Southwell, speaking for the entire Technical Committee, took the opportunity to express the appreciation of the group to Dr. E. J. Warwick for the excellent work he has done as Regional Coordinator and to wish him every success in his new position in charge of the Beef Cattle work of the U.S.D.A. He also mentioned that as a token of esteem, the group will present Dr. Warwick with a suitable piece of luggage which will be sent to him soon by his Uncle Bruce who is the secretary.

Dr. Warwick thanked the group, expressed his pleasure and stated that he had enjoyed his work more than with any group with which he had ever worked, and that he expected to be around and working with the group in his new position.

The formal meeting was adjourned at 9 P.M.

STATISTICAL GENETIC STUDIES IN CORN AND IMPLICATIONS OF THE RESULTS IN BEEF CATTLE BREEDING

H. F. Robinson
North Carolina Experiment Station

The investigations of quantitative inheritance in corn by the statistical genetics personnel at this station were started nine years ago to answer questions raised by the corn breeders. These questions were concerned with the importance of overdominance in genes conditioning yield, effectiveness of various types of selection procedures with methods of predicting progress, and the more general problem of the comparison of the effectiveness of existing breeding methods and possible development of new schemes.

Primary objectives with populations of hybrids and open-pollinated varieties have been (1) estimation of level of dominance involved in the action of the genes, (2) measurement of additive genetic variance, and (3) comparison of actual with predicted progress in selection studies. Although other characters have been studied, chief interest has been with grain yield.

Two experimental procedures have been used in the estimation of additive genetic and cominance variance. In the scheme designated Design I half-sib matings are made among plants within a population where each plant used as a male is crossed with four different plants used as female parents. Approximately 256 such progenies constitute the replicated field test of a population where progenies are arranged in small sets of four randomly allotted male groups or 16 progenies. From the components of variance estimated from the variance analysis of data obtained, an estimate of additive genetic and dominance variance is provided.

With the procedure designated Design III the experimental material is produced from back cross mating of plants of a segregating generation of a population to the two homozygous lines from which the population was derived. Plants of the segregating population are used as male parent. A set of progenies is made up of 2 n pairs of progenies obtained from back crossing n randomly chosen

plants used as males to each of the parent lines. The experimental material for a population consists of approximately 10 sets of n = 10 pairs of progenies in each set replicated in a randomized complete block arrangement.

In Design III and with a population having a gene frequency of 0.5, the component of variance due to genetic differences among male parents provides an estimate of the additive genetic variance. The dominance variance is estimated from the progeny variance arising from interaction of genes of male and inbred parents.

The major portion of the experimental work has been carried out according to the Design I procedure. The additive genetic and cominance variance has been estimated in the F_2 generation of various hybrid populations and in three locally adopted open-pollinated varieties. Selection studies for yield improvement have been carried out with two of the hybrid populations and in the open-pollinated populations. Chief objectives in selection studies have been to (1) Compare the predicted progress with the actual gain realized in subsequent generations and (2) determine the rate at which the additive genetic variance is dissipated. Cyclic selection in each population has been done in the following manner. Following the initial Design I studies in the F_2 generation of hybrids and in the foundation source of the varieties remnant seed of the superior yielding five per cent of the progenies in each population is used to obtain plants for making intra-population matings, thus commencing the cycle of selection. In the second year of the cycle matings are made between plants of the selected crosses to produce the recombined population. The following year the recombined population is grown and matings made as described for Design I. The biparental progenies are tested in either one or two years in replicated plots, completing the cycle.

The genetic variances have been investigated in two hybrid populations using Design III. The material which has been studied with each of the procedures, year of tests and number of progenies contained in each are given in Table 1.

Table 1. Type and Amount of Material Studied in Replicated Field Tests

Design I				Design III		
Population	Generation or Stage of Selection	Date of Test	Number of Progenies	Generation	Date of Test	Number of Progenies
Hybrids						
CI21xNC7	F_2	1947	252	F_2	Sample I 1950	67
	Selection I	1950-51	256		1951	47
					Sample II 1951	100
	Selection II	1954-55	256			
NC34xNC45	F_2	1947	173			
	Selection I	1950	256			
	Selection II	1953	256			
NC16xNC18	F_2	1947	284			
NC33xK64				F_2	Sample I 1950	89
					1951	45
					Sample II 1951	74
Varieties						
Jarvis	Original Variety					
	Sample I	1950-51	256			
	Sample II	1952-53	256			
	Selection I	1954-55	256			
Weekley	Origional Variety					
	Sample I	1950-51	256			
	Sample II	1952-53	256			
	Selection I	1954-55	256			
Indian Chief	Original Variety					
		1952-53	512			

The results pertaining to genetic variances can be summarized as follows: (1) Appreciable amounts of additive genetic variance appears to remain in the open-pollinated varieties even though it has been generally reported that selection for further yield improvement is ineffective; (2) Of the two hybrid populations in which selection studies have been carried on, considerably more additive genetic variance was indicated for genes conditioning yield in CI21 x NC7 than was the case for NC34 x NC45. This is in agreement with yield improvement which has been effected in these populations; and (3) The predicted and actual progress from selection is in general agreement for both hybrid populations and open-pollinated varieties (Table 2).

Table 2. Comparison of Predicted and Actual Gain in Yield from Selection

Population	Selection Cycle	Predicted Gain[1] (% of Population Mean)	Average Amount of Inbreeding (%)	Actual Gain (% of check)
CI21 x NC7	First	9.7[2]		10.4
	Second	5.1	4.75	9.5[3]
	Total	14.8		
NC34 x NC45	First	4.0		11.1
	Second	0.3	5.22	(-12.6)[3]
	Total	4.3		
Jarvis	First	15.5	3.52	7.2[3]
Weekley	First	10.9	2.59	10.3[3]

[1] Predicted Gain = $\frac{(\text{Selected group } \bar{x} - \text{Population } \bar{x})\ (\sigma_g^2/2)}{\sigma_p^2}$

[2] Based on the average estimate of σ_g^2 from Design I and III.
[3] Adjustment has been made for the inbreeding which has occurred.

(4) Genes affecting yield of grain, for the most part, show partial to complete dominance. If there is overdominance it exists at only a portion of the effective loci.

(5) The indicated level of dominance of genes in some F_2 generations of hybrids developed from crossing isogenic lines is different from that indicated in open-pollinated varieties. Upward bias due to linkage effects in the estimates of dominance variance in hybrid populations is suggested to account for pseudo-overdominance. Work in progress is designed to provide information on magnitude of the linkage bias in estimates of level of dominance in hybrid populations.

(6) A reciprocal recurrent selection breeding program is being conducted using the two varieties, Jarvis and Indian Chief as the foundation stocks. These populations were chosen as basic groups for two reasons:

(a) The presence of genetic variation within each of the varieties.

(b) The yield performance of the cross of these two varieties approaches the yield obtained with adapted commercial hybrids.